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Heating • Refrigerating • Air Conditioning • Ventilating

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS

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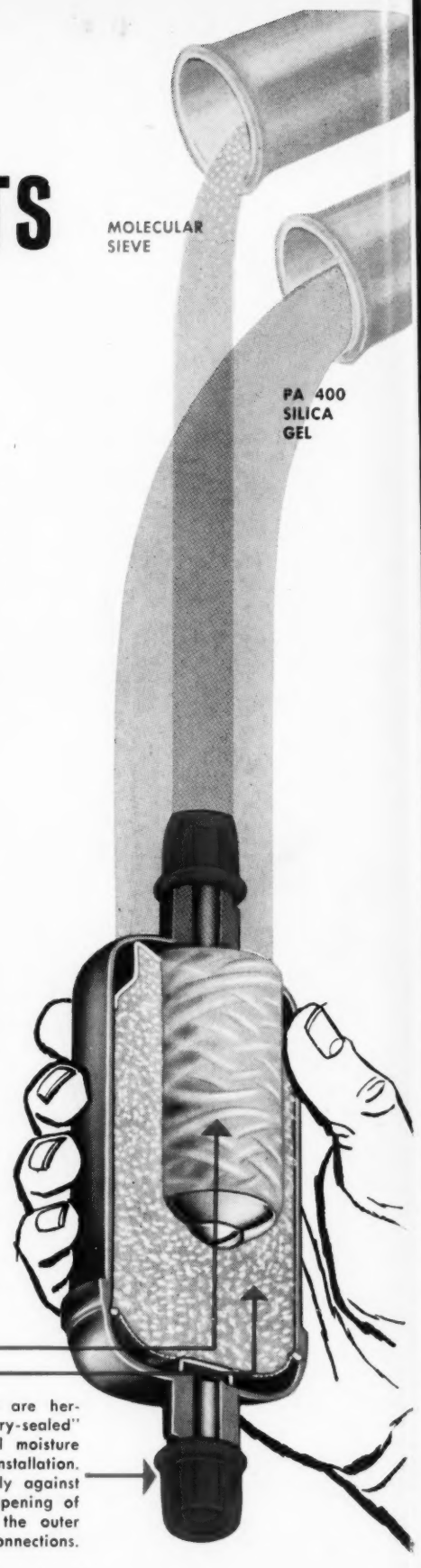
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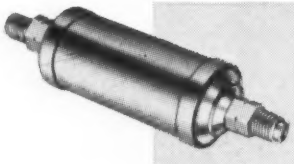
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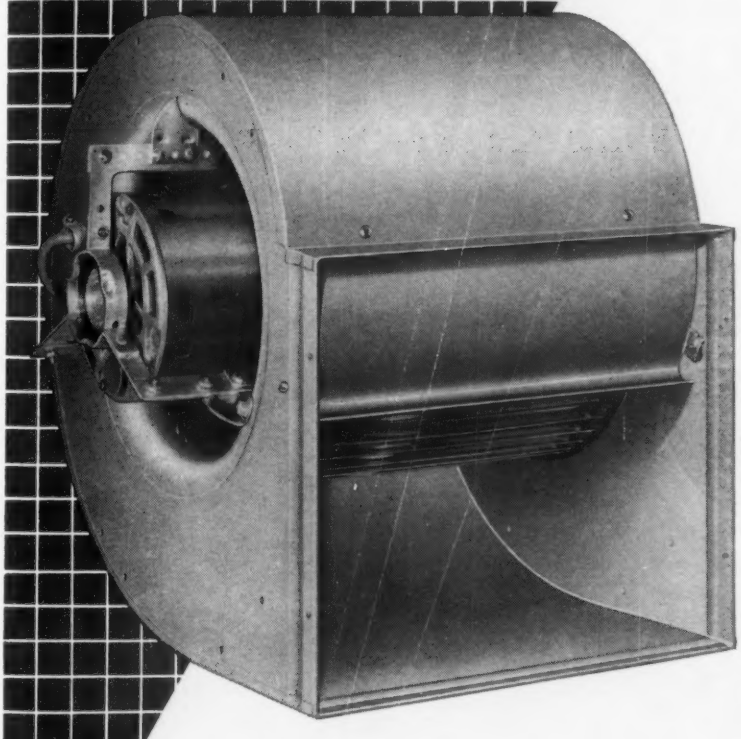
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MARCH
1960

VOL. 2 NO. 3

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JOURNAL

Formerly Refrigerating Engineering including Air Conditioning, and incorporating the ASHAE Journal.

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Comment

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HOME FROM THE RANGE

Post-Dallas, we see ASHRAE stronger than ever before. Stronger in leadership. Stronger in intensity of purpose. Stronger in organization of activities and stronger in plans for accomplishment at the Chapter level. The newer concept of Regional effectiveness is making its values clearly evident.

All in all, Dallas was a truly stimulating occasion. Not only was this ASHRAE Semiannual Meeting well-planned as to program and events but the Second Southwest Heating and Air-Conditioning Exposition was notable for its indication of what can be done when emphasis upon local conditions is given its rightful place in a non-national exhibition.

We have the feeling, too, that out of the present shortness of terms of ASHRAE officers, merger-plan necessitated, has emerged a somewhat longer term view of plans and program for the Society. That successive administrations will be thinking more directly of the interval between their own initiation and four and five years to come rather than of step-by-step successions, though the very nature of our Society is one of related consecutive procedures.

It seems that the Vancouver Meeting this June strikes a responsive note in many of us. True, it comes shortly upon its predecessor, but it promises to be well attended.

Shall we see you there?

SOME FOLKS DON'T CARE

"What", posed the Senator "has Posterity ever done for us?" One of those more ultimate observations; so unanswerable as to deserve a reply by its sheer absoluteness.

Well, we think of this plundered planet, stripped of its oil and gas deposits, robbed wantonly of its forests, gazing ruefully at what were once noble waterfalls and other natural resources and before long to be reduced to the re-use of metals and other materials as they, too, all but disappear. We think of our depressed water tables and polluted atmosphere.

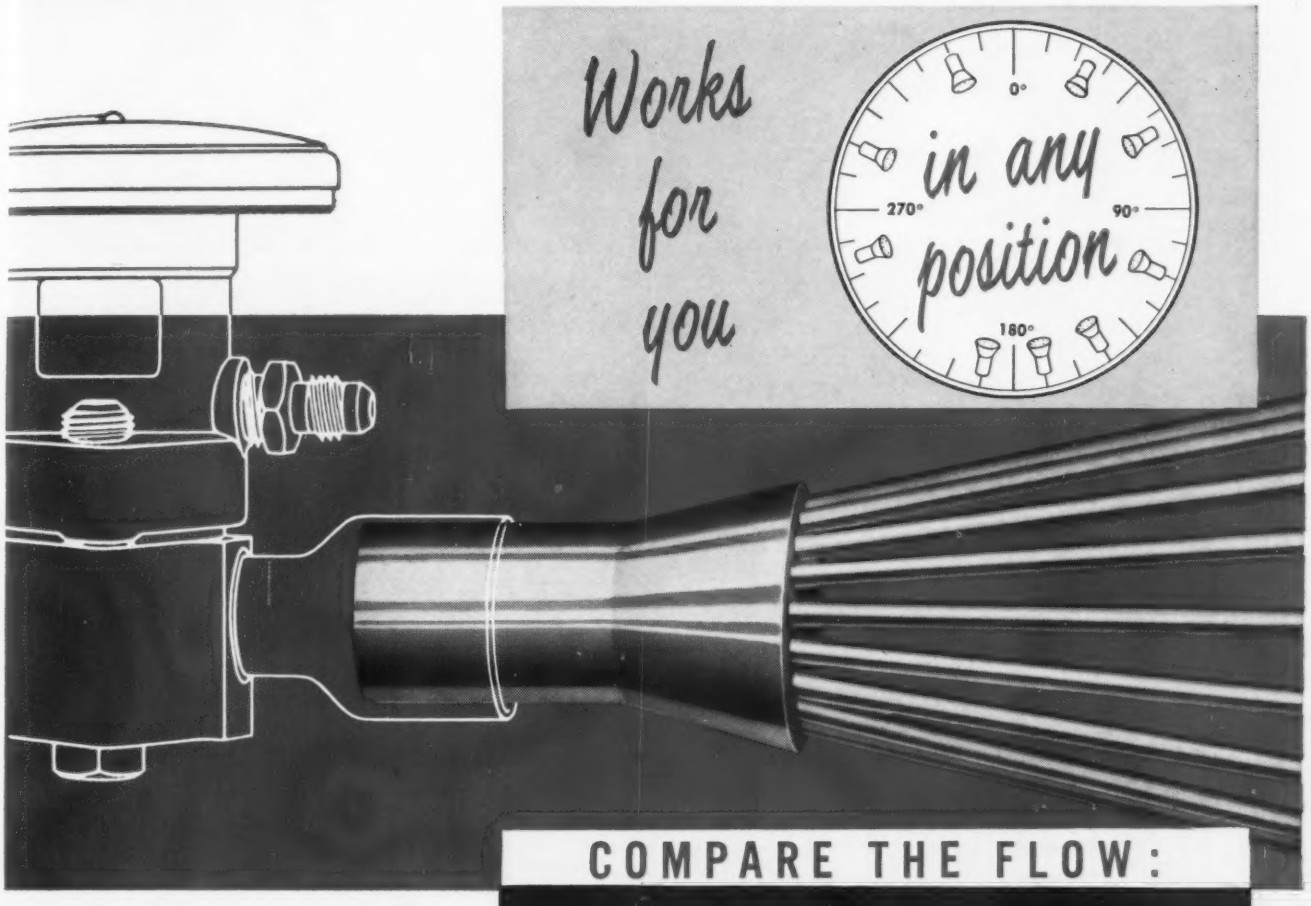
We think of the great upsurge of global population and the advances in science and medicine which end up by strengthening and prolonging the existence of the weak and disease-impaired without correspondingly improving the strong. Of the sentimentality which has all but wrecked our educational system in pursuit of equality for the unequal.

Why, Senator! Your question should be, what would Posterity do to us if it could get a hold of us: all so long gone and individually forgotten by Tomorrow?

Edward R Searles
Editor

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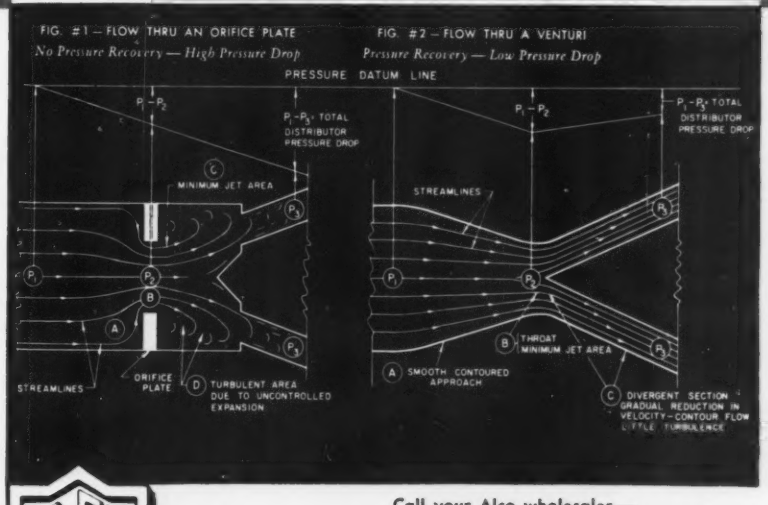
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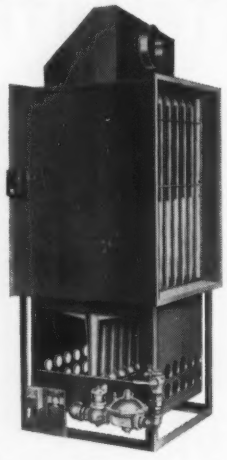
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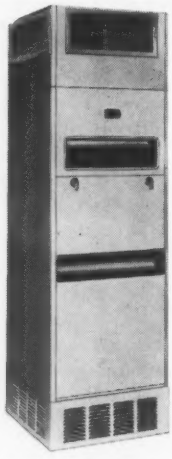
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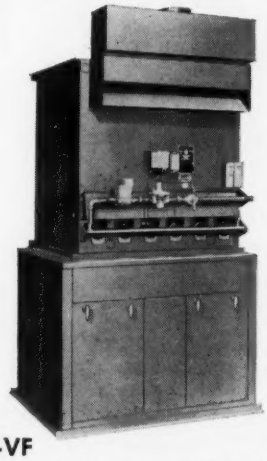
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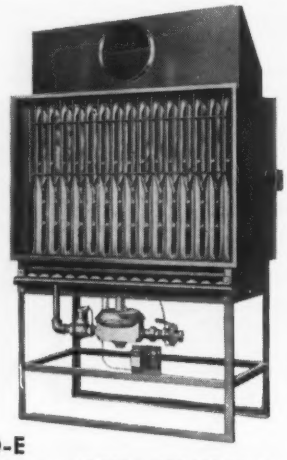
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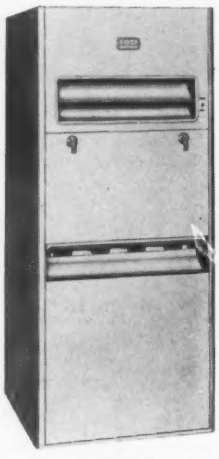
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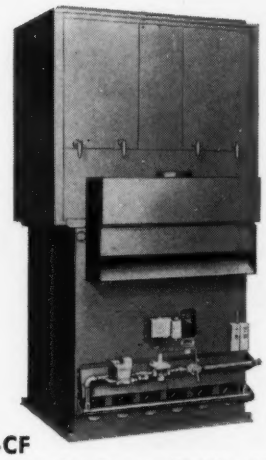
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UP Vertical Duct Furnace, 70,00 to 280,000 BTU



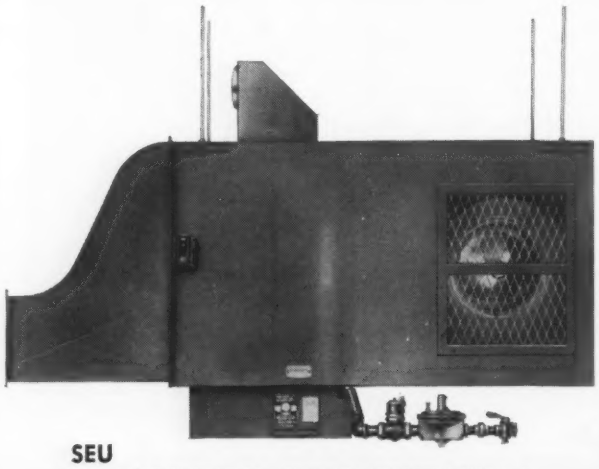
SED-E
Duct Furnace, 45,000 to 675,000 BTU Imput—Side Surface



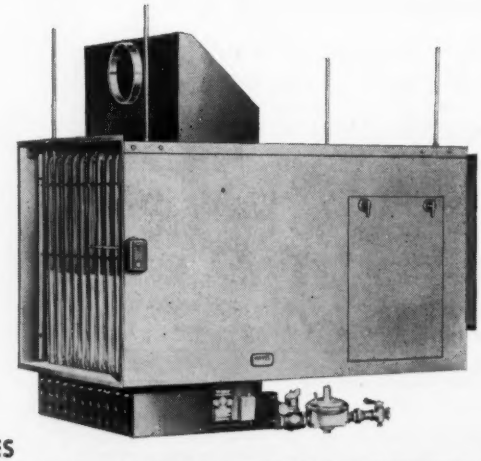
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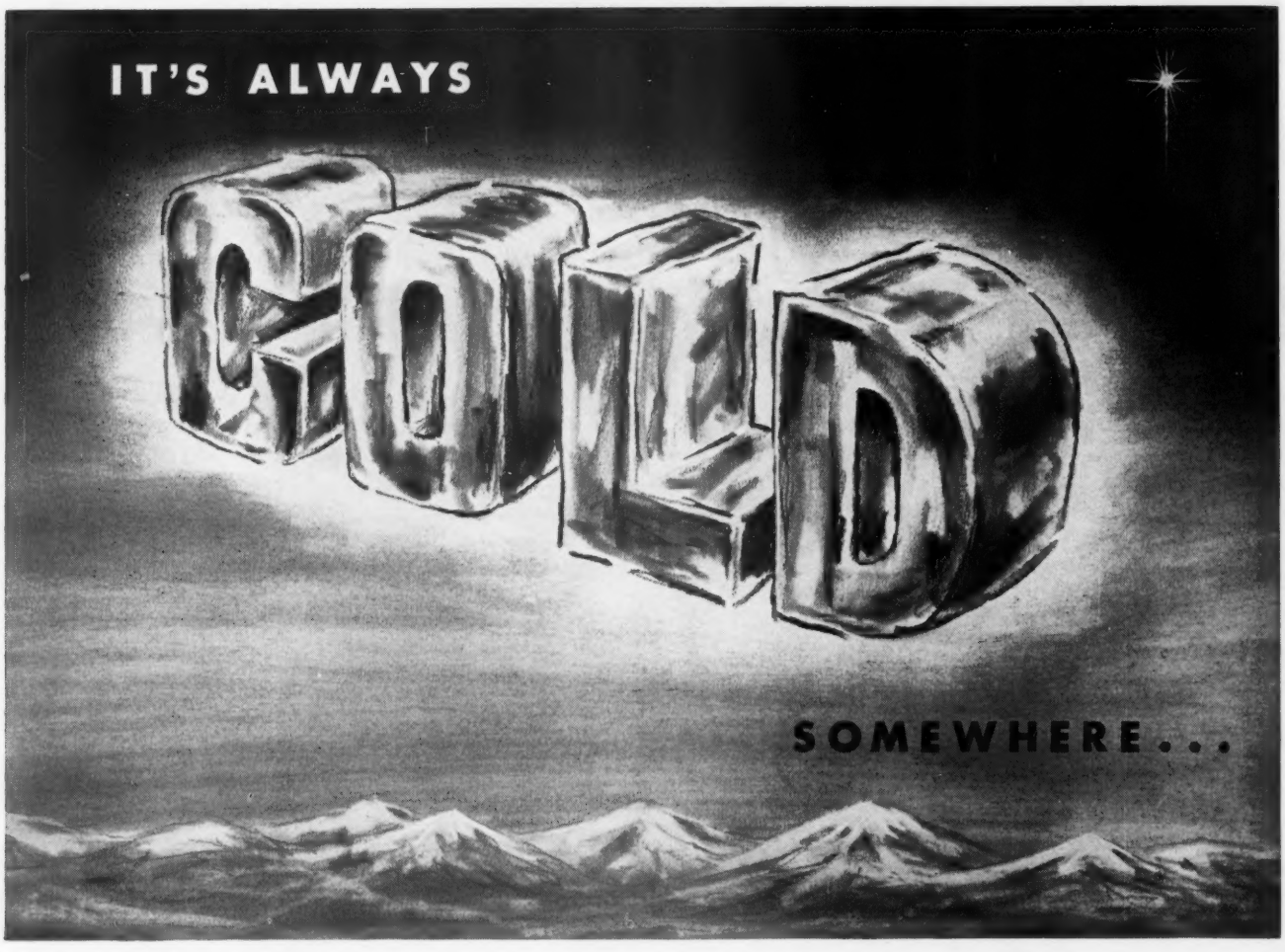


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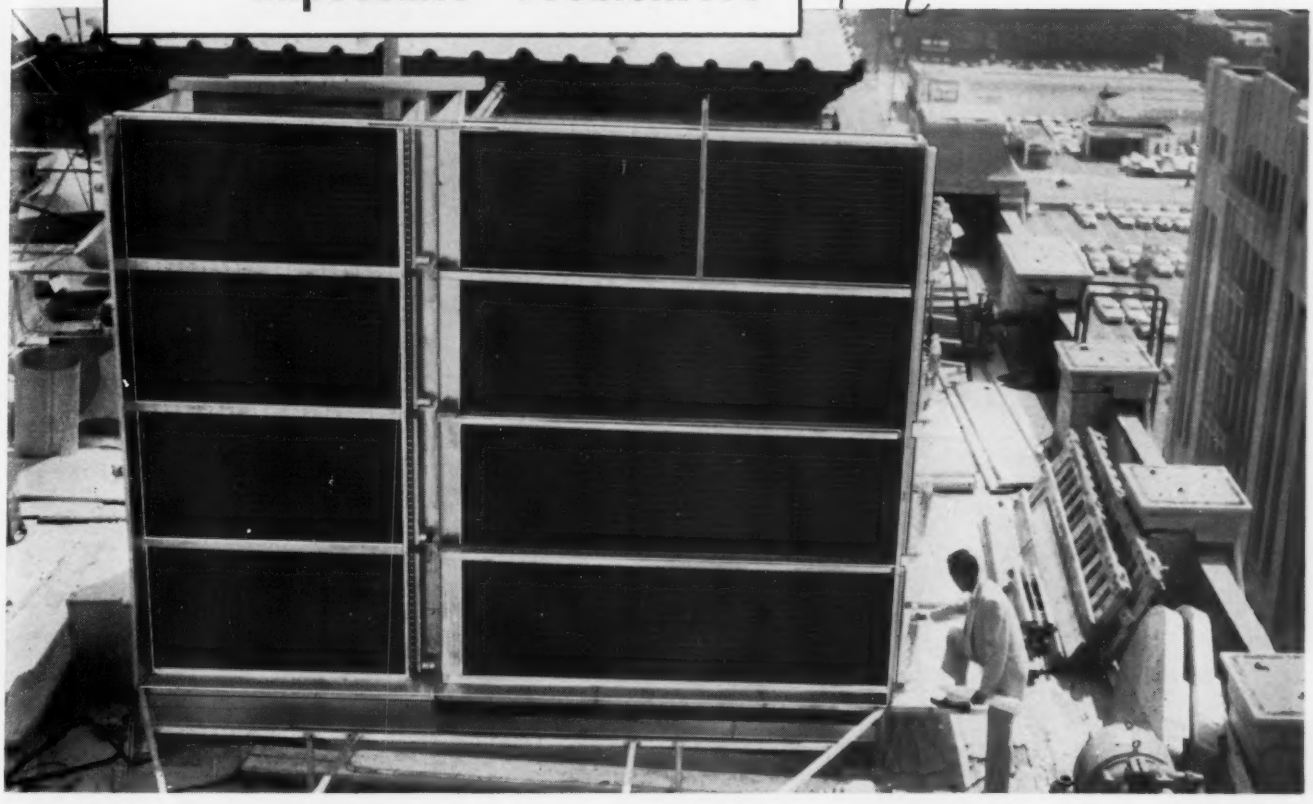
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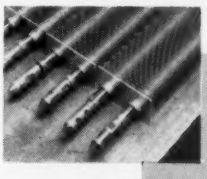
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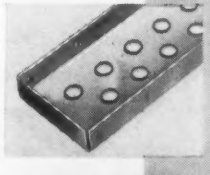
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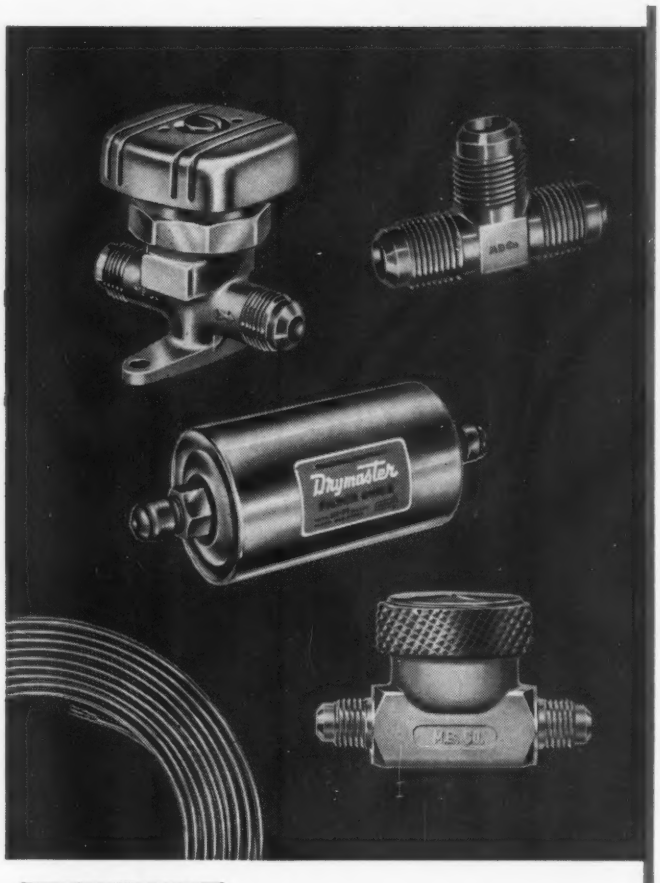
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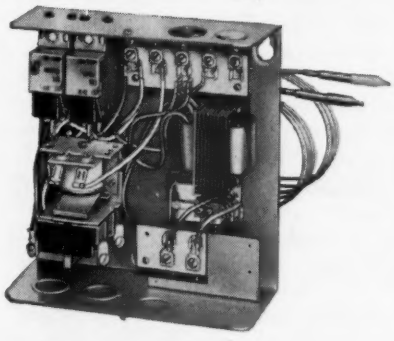
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interlocks in one unit all heating-cooling functions for self-contained systems.

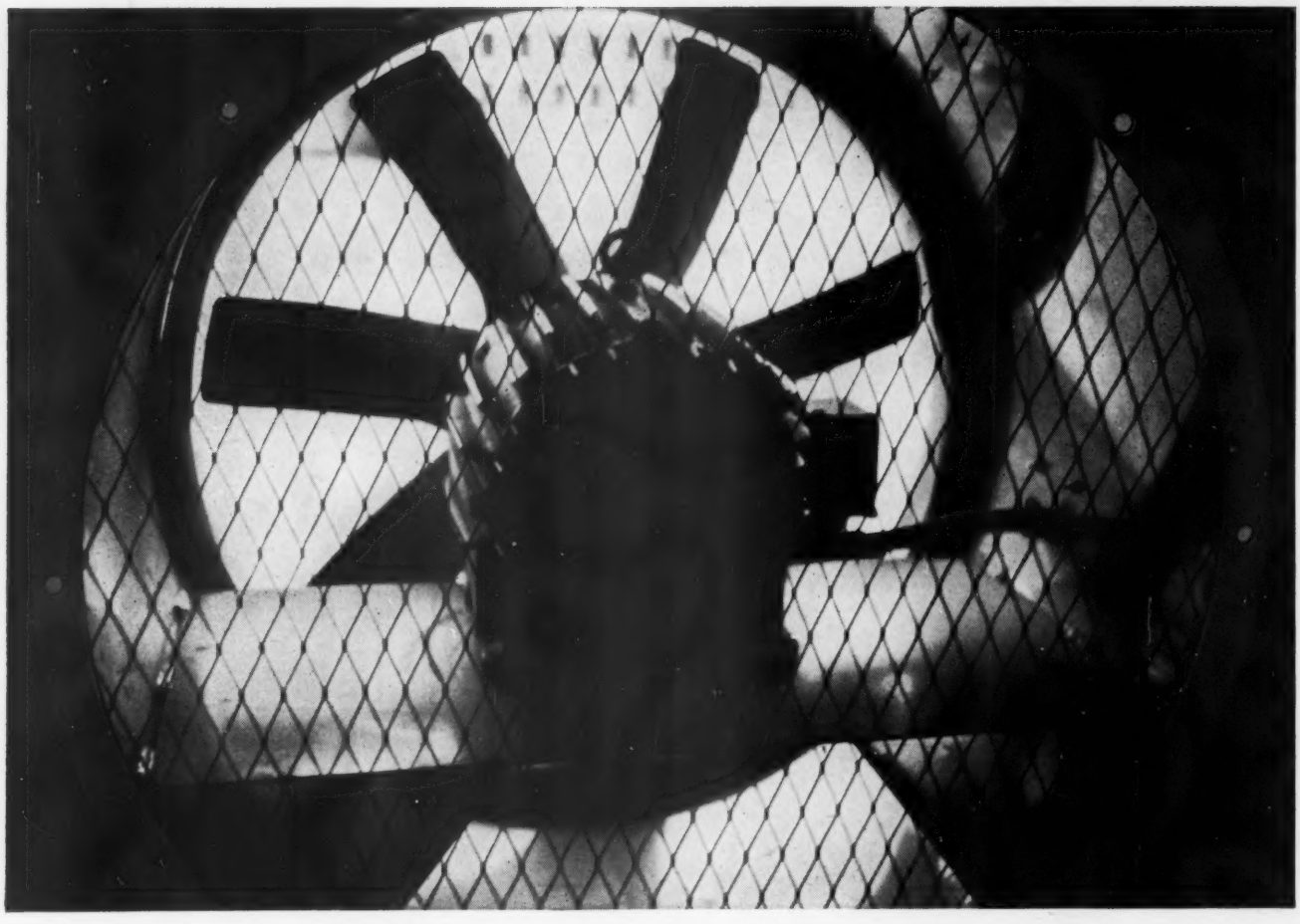
In Penn's newest line of Control Centers, field-replaceable parts are easy to get out . . . easy to get in *correctly* because all internal wiring is color coded. And, these color-coded leads are equipped with *quick-connect terminals* . . . no more looping of wire or soldering connections.

There are other advantages, too! Centers are small to save space in compact 2 and 3 H.P. units. Wrap-around cases save wiring time in factory and field. And, field-installed Fan Centers have Life Guard reverse panel construction. All operating parts are easily accessible, yet are fully protected against accidental damage. Write to the Penn factory for the complete story on these new, better Control Centers.

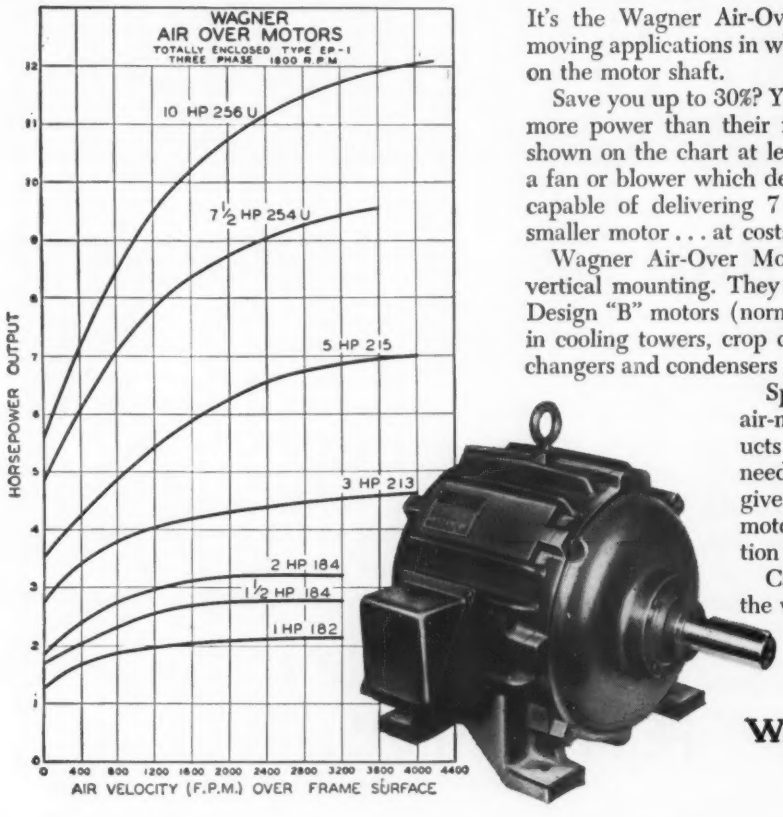
PENN CONTROLS, INC. Goshen, Indiana

EXPORT DIVISION: 27 E. 38th ST., NEW YORK, N.Y.

AUTOMATIC CONTROLS FOR HEATING, REFRIGERATION, AIR CONDITIONING, APPLIANCES, PUMPS, AIR COMPRESSORS, ENGINES



This Wagner Motor can save you up to 30% in costs on air-moving equipment



It's the Wagner Air-Over Motor . . . *specifically* designed for air-moving applications in which a propeller or axial flow fan is mounted on the motor shaft.

Save you up to 30%? Yes, for Wagner Air-Over Motors can deliver more power than their rated horsepower output. For example, as shown on the chart at left, a 5 horsepower rated motor installed in a fan or blower which delivers about 4,000 feet of air per minute is capable of delivering 7 horsepower. You get more work from a smaller motor . . . at costs up to 30% less.

Wagner Air-Over Motors are suitable for either horizontal or vertical mounting. They are totally-enclosed, nonventilated NEMA Design "B" motors (normal torque—normal slip). You can use them in cooling towers, crop dryers, exhaust systems, air-cooled heat exchangers and condensers . . . any air-over fan and blower application.

Specify Wagner Air-Over Motors for all your air-moving equipment applications. Your products will operate at peak efficiency for years, need less service and fewer repairs. And, you'll give your customers equipment powered by motors they know . . . motors that have a reputation for long, dependable service.

Call your Wagner Sales Engineer now . . . get the whole Wagner Air-Over Motor story. There are Wagner Branches in 32 principal cities across the country.

Wagner Electric Corporation
6379 Plymouth Ave., St. Louis 33, Mo.

WM60-13



SPORLAN

Famous Firsts...

...for Peak Performance Air Conditioning!

Sporlan *Catch-All*... the first molded porous core filter drier... Sporlan's amazing *See-All* the first combination moisture and liquid indicator... Sporlan Solenoid Valves with the layer wound Blue Seal Coil... Sporlan Thermostatic Expansion Valves with the original *FLOWMASTER* element and Refrigerant Distributors with the versatile interchangeable nozzle...

offer ***You*** *a perfect combination engineered to fit any size installation... right down the line!*

Ask your friendly Sporlan Wholesaler for your copy of Condensed Catalog 58 today!



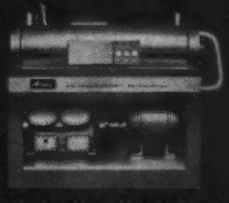
SPORLAN VALVE COMPANY

7525 SUSSEX AVENUE · ST. LOUIS 17, MISSOURI

EXPORT DEPT: 85 BROAD ST., NEW YORK 4, N. Y.

Acme ...the **practical** approach to air conditioning





Tested and certified packaged chillers



Single and multi-zone air handling units



Cooling towers and evaporative condensers



Self-contained air conditioners

Acme air conditioned in just two weeks!

That's right! A 75-ton Acme cooling system for comfort conditioning the temple area, meeting rooms and catering facilities at the Jewish Community Center, West Hempstead, Long Island, was installed and in operation in a period of just *two weeks* . . . an undertaking that would normally require closer to *two months* to complete.

That's a reduction in installation time of approximately 75% . . . a fact that can be attributed in considerable measure, certainly, to the excellent caliber of service rendered by the Warren Contracting Corporation, Bethpage, Long Island . . . a fact that can also be attributed to the Acme equipment used. For Acme system components offer easy-to-handle lightness, space-saving compactness, factory-packaged simplicity . . . features that are attested to by Mr. Calvin Berch, Warren Contracting engineer who, with particular reference to Acme's Flow-Therm chiller, states: "We are extremely pleased with the Acme cooling unit. It's a neatly packaged, lightweight, compact unit which fits into tight quarters and requires a minimum of floor space."

Acme advanced engineering has resulted furthermore, in greater capacity, better efficiency, less maintenance per cubic foot, per pound, per dollar invested than you'll find in any other air conditioning system equipment currently on the market.

So, if you're looking for a *practical* approach to your air conditioning needs, look to Acme.

Acme

INDUSTRIES, INC.

JACKSON, MICHIGAN

Manufacturers of Quality Air Conditioning and Refrigeration Equipment Since 1919

Late news highlights

NBS reports Reporting upon significant developments in the research program of the Bureau during the past year, "Research Highlights of the National Bureau of Standards, Annual Report 1959" describes a wide range of scientific studies, laboratory experiments and instrumentation developments. Additionally, the Report summarizes the Bureau's Calibration, Testing and Standard Sample programs, publications program and cooperative research with industry and outlines briefly some of the projects planned for the coming year. This illustrated 169-page report, NBS Miscellaneous Publication 229, is available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., for 55 cents.

One package New polyester films that look like cellophane and which are said to endure temperatures from below zero to 240 F without change, will make it possible for frozen foods to be packaged and cooked or heated in water without removal from this bag, according to J. D. Winter, in charge of the University of Minnesota's food processing laboratory.

Dairy conference held As part of the Eighth Annual National Dairy Engineering Conference, held at Michigan State University, East Lansing, Mich., February 23 and 24, Leon Buehler, Jr., a Past President of former ASRE, discussed "An Evaluation of Refrigerants."

Engineering fellowships Twenty-seventh annual program of Tau Beta Pi Fellowships for graduate study in engineering during the school year 1960-61 has been announced. All Tau Beta Pi members are eligible for the fellowships which are worth $1800. Information relating to the program may be obtained from Paul H. Robbins, Director of Fellowships, 2029 K Street, N.W., Washington 6, D.C.

Enrollments declining This country must take action now to insure the availability of enough engineers and the right kind of engineers to meet the expanding demand for technical services of the 1960's, cautions a report by the Engineering Manpower Commission of Engineers Joint Council, which reveals that freshman engineering enrollment has declined for the second consecutive year, over 3% in 1959 after an 11% drop in 1958, as reported by the U. S. Office of Education.

Where to find it National Science Foundation is publishing a series of reports describing the activities of various agencies of the U. S. Government in providing scientific information to the public. "Scientific Information Activities of Federal Agencies, November 1959, Number 3, U. S. Department of Commerce – Part I" may be obtained from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., price is 15 cents.

New name Effective April 1, 1961, the National Industrial Service Association, Inc., will officially become the Electrical Apparatus Service Association, Inc. This change is in answer to requests by members for a more descriptive name of the activities of the association's member firms, which are independently owned companies primarily engaged in the repair and rewinding of industrial motors, generators and transformers.

Occupation Handbook Listings of 600 occupations and professions, describing employment outlook, nature of work, qualifications needed and working conditions, including an 80-page review of the engineering and science fields, have been compiled in **Occupational Outlook Handbook,** 1959 Edition, released by the Department of Labor. This 800-page volume is available from the Superintendent of Documents, Washington 25, D. C., or regional offices of the Bureau of Labor Statistics for $4.25. Supplemental information on new developments is published in the Occupational Outlook Quarterly, price of annual subscription is $1.

Solar Energy Symposium

Mechanical Engineering Department of the University of Florida and the Solar Energy Applications Committee of the American Society of Mechanical Engineers will sponsor a Solar Energy Symposium on April 4 and 5, 1960, at the University in Gainesville, Fla. Seven or eight sessions are planned to include Present Importance of Solar Energy, Basic Considerations, Solar Collectors, Water Heating, Furnaces, Refrigeration and Distillation.

Scientific exchange

During the next six months Engineers Joint Council will undertake a "Visiting foreign scientists program in engineering" to broaden the scientific perspective of faculties and graduate students in engineering through interchange of scientific knowledge and research concepts with prominent foreign scientists. Program is made possible by a grant of $25,000 from the National Science Foundation.

ECPD annual report

Reports of the Council and various committees on past activities and present and proposed projects are included within the 27th Annual Report – 1958-59 of the Engineers' Council for Professional Development, 29 West 39th Street, New York 18, N. Y., together with a report of its 27th annual meeting. Included are listings of accredited curricula leading to degrees in engineering and accredited technical institute programs, as well as the names of standing and special committees.

Research goals

Scientific and technological advances could be speeded if this country's research and development were conducted under conditions which would stimulate greater originality. This is the consensus of opinion of 51 scientists, researchers and educators who met December 3 and 4 at Worcester Polytechnic Institute at the Conference on Research Goals, which was sponsored by the National Science Foundation in cooperation with 15 scientific and engineering societies.

World Power Conference

"Methods for Solving Power Shortage Problems" is the general theme of the next sectional meeting of the World Power Conference to take place in Madrid, Spain, June 5-9. In addition to technical sessions, visits to plants in the vicinity and cultural trips are being planned.

ARI to be on Coast

12th Exposition of the Air-Conditioning and Refrigeration Industry will be held in Los Angeles, Calif., February 12-15, 1962. ASRE Past President H. F. Spoehrer, Chairman of the ARI Show Policy Committee, explained that the "decision to move the 1962 show to the West Coast is in recognition of the tremendous population and industrial growth of the area, its increasing importance as a major market for the products of our industry and a desire to make it possible for many people to attend the ARI show who have not found it convenient, or possible, to travel to Chicago or Atlantic City."

Proposals for revision

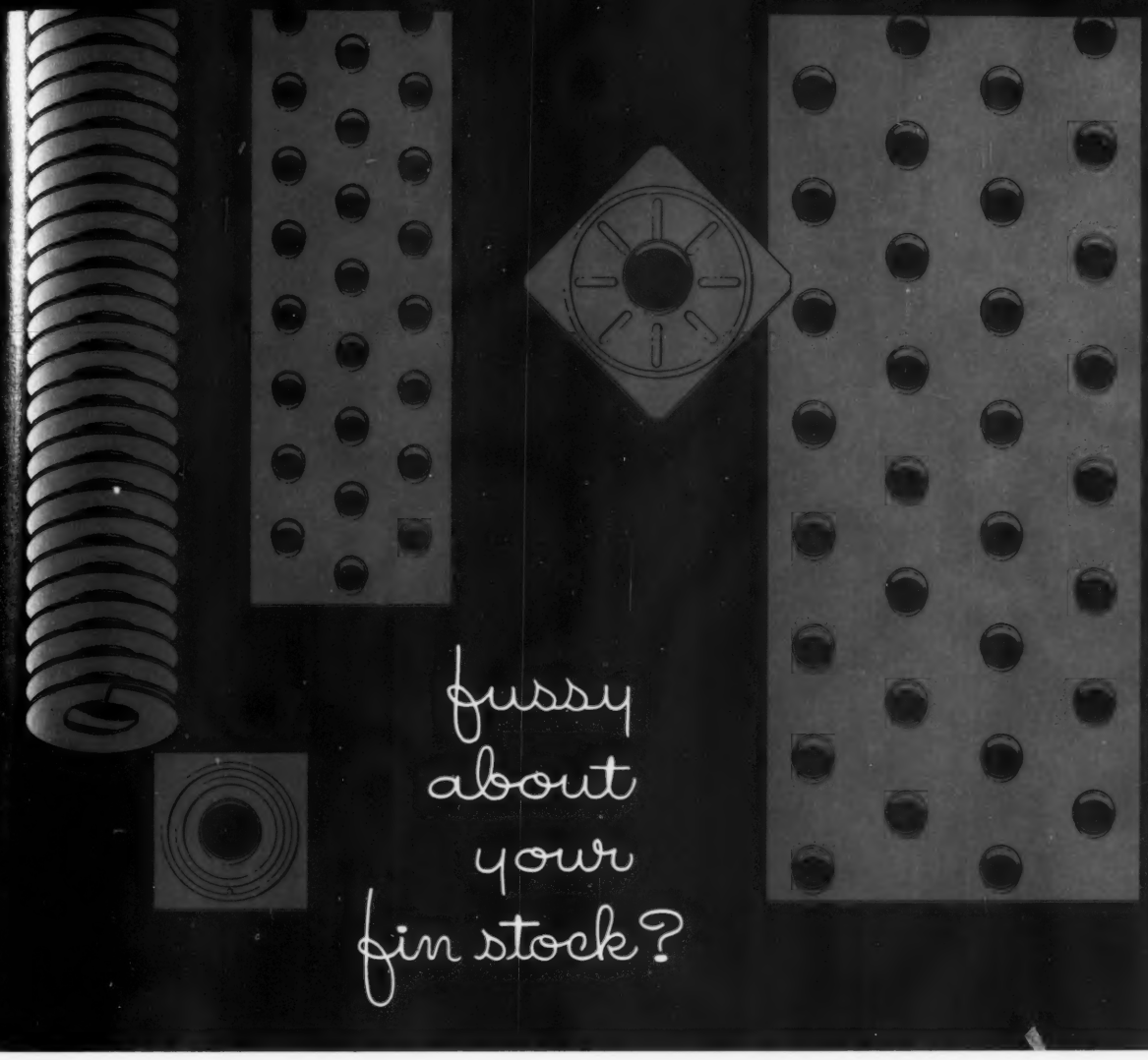
National Society of Professional Engineers has presented a five-point proposal for revising the Federal Classification Act to the House Committee on Post Office and Civil Service to improve the Government's competitive position in the recruitment and retention of adequate numbers of qualified engineers and scientists. The recommendations relate to the Federal classified pay system and salary laws.

Engineers from India

Sponsored by the International Cooperation Administration, a group of seven engineers representing the government and industry of India will spend five months at Lehigh University, Bethlehem, Pa., studying industrial engineering.

ASHRAE NATIONAL MEETINGS AHEAD

1960	1961	1962	1963
June 13-15 Annual Vancouver, B.C.	Feb. 13-16 Semiannual Chicago, Ill.	Jan. 28-Feb. 1 Semiannual St. Louis, Mo.	Feb. 11-14 Semiannual New York, N. Y.
	June 26-28 Annual Denver, Colo.	June Annual Miami, Fla.	



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No matter what methods of fabrication and assembly you are using, let Scovill Technical Service suggest a better fin stock specification ... SCOVILL TRUSPEC ALUMINUM SHEET.

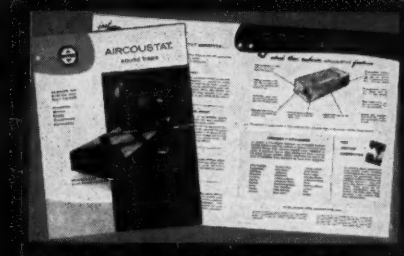
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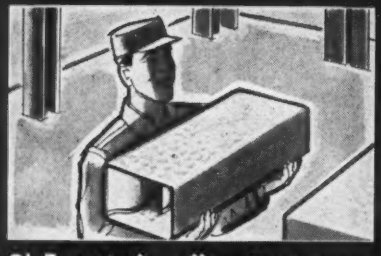
SCOVILL MANUFACTURING COMPANY, Mill Products Division, 99 Mill Street, Waterbury 20, Connecticut. Phone PLaza 4-1171.

7 ways AIRCOUSTAT®
can save you time and money

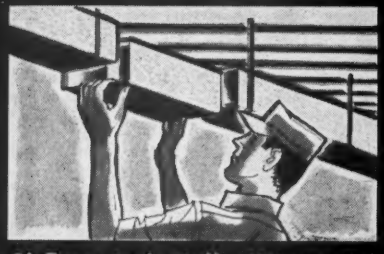
Sound Traps . . . with Guaranteed Results



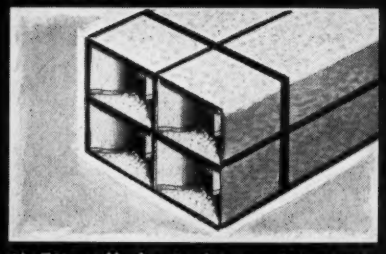
1) Easy to select—Just 3 steps to specify proper model. Save time, avoid errors.



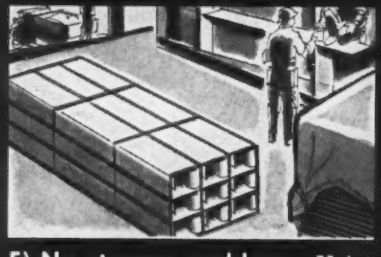
2) Easy to handle—No riggers or special equipment needed. Large units composed at job site.



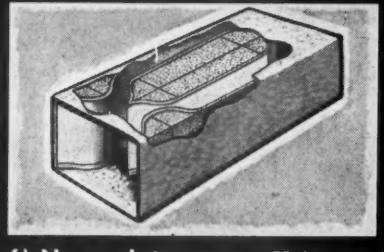
3) Easy to install—Units are installed the same as ductwork. Units have 2" extensions.



4) Fits all duct sizes—Big units are easily assembled from small Aircoustat units.



5) No storage problem—Units are delivered right to the job site, ready to install.



6) No maintenance—Units are fire-resistant, dust-proof and built to last a lifetime.



7) Guaranteed results—Solves every noise reduction problem. Units are completely reliable.

Pre-engineered by Koppers to eliminate guesswork, unnecessary calculations and difficult installations, AIRCOUSTAT Sound Traps guarantee trouble-free silencing of all duct-transmitted noise . . . at a savings in time and money to you.

AIRCOUSTAT selection is quick, simple and reliable. A choice of over 60 stock models, fabricated in 6 lengths, solves every noise reduction problem. AIRCOUSTAT is built to give a lifetime of maintenance-free service.

Write today for your copy of the AIRCOUSTAT Selection Manual, a quick guide to the right unit or combination of AIRCOUSTAT units to eliminate duct-transmitted noise in all air handling systems. Write KOPPERS COMPANY, INC., Sound Control Department, 3503 Scott Street, Baltimore 3, Maryland.

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SOUND CONTROL

METAL PRODUCTS DIVISION

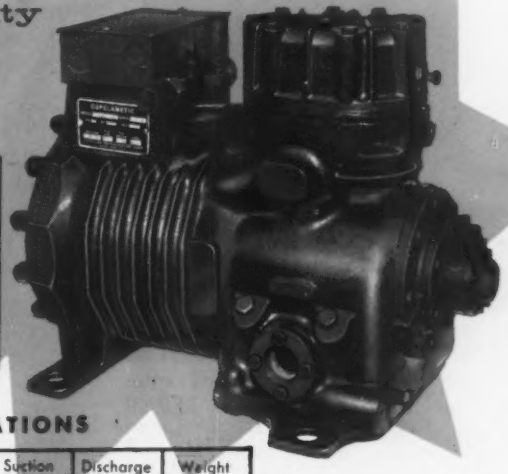
Engineered **Products Sold with** ***Service***

For air conditioning and heat pumps... Copeland has what it takes!

Copelametic suction-cooled motor-compressors through 30 H.P. ••• a model for every application ••• rugged, reliable design proved by years of field experience ••• longer life due to highest quality control standards ••• accessible hermetic ••• positive lubrication

MODEL NR46-500

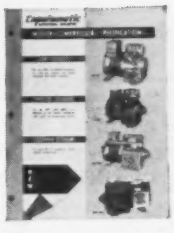
Two-cylinder, 5 H.P. motor-compressor designed to operate at 1750 R.P.M. using Refrigerant-22. Dimensions: L—20¾"; W—13"; H—16⅝". This model is typical of many that make Copelametics the outstanding motor-compressors for heat pumps . . . leaders in output, reliability and economy.



Copelametic MOTOR-COMPRESSOR SPECIFICATIONS

Model	H.P.	Cyls.	Appl.	Bore	Stroke	CFH Disp. @ 1750 R.P.M.	Refr.	Oil Rech. ozs.	Length	Depth	Height Over Mountings	Mounting Centers*	Suction S.O.V. Tube O.D.	Suction S.O.V. Type	Discharge S.O.V. Tube O.D.	Discharge S.O.V. Type	Weight Net	Weight Ship.
8R6-200	2	2	H	1 15/16"	1⅜"	492.4	R-12	72	16⅛"	12"	14"	10 1/16" x10½"	⅞"	S	⅝"	F	151	160
9R1-200	2	2	H	1¾"	1 9/32"	339.0	R-22	72	16⅛"	12"	14"	10 1/16" x10½"	⅞"	S	⅝"	F	151	160
3R42-300	3	2	H	2 5/16"	1⅜"	701.0	R-12	88	18 1/16"	13"	13 13/16"	11" x11⅝"	1⅛"	S	⅝"	F	188	197
8R28-302	3	2	H	1⅞"	1⅜"	460.0	R-22	72	17½"	12"	14"	10 1/16" x10½"	1⅛"	S	⅝"	F	174	183
LRH-420	4	2	H	2¼"	1 7/16"	698.0	R-22	88	19 7/16"	13"	16⅝"	11" x11⅝"	1⅛"	S	⅝"	S	228	237
NR40-400	4	2	H	2¼"	1 7/16"	698.0	R-22	88	20¾"	13"	16⅝"	11" x11⅝"	1⅛"	S	⅝"	S	231	240
LRG-520	5	2	H	2 7/16"	1 7/16"	815.0	R-22	88	19 7/16"	13"	16⅝"	11" x11⅝"	1⅛"	S	⅝"	S	231	240
NR46-500	5	2	H	2 7/16"	1 7/16"	815.0	R-22	88	20¾"	13"	16⅝"	11" x11⅝"	1⅛"	S	⅝"	S	234	243
MRF-500	5	2	H	2½"	1 13/16"	1080.0	R-12	96	23"	13"	18 3/16"	11" x11⅝"	1⅜"	S	⅞"	S	265	281
MRG-750	7½	2	H	2 7/16"	1 13/16"	1020.0	R-22	96	23⅞"	13"	18 3/16"	11" x11⅝"	1⅜"	S	1⅛"	S	285	301
MR50-760	7½	2	H	2 9/16"	1 13/16"	1136.0	R-22	96	23⅞"	13"	18 3/16"	11" x11⅝"	1⅜"	S	1⅛"	S	285	301
9R9-750	7½	3	H	2⅜"	2"	1620.0	R-12	128	26 1/16"	14"	18¾"	12" x15"	1⅜"	S	1⅛"	S	318	333
9R8-1000	10	3	H	2 3/16"	2"	1375.0	R-22	128	27½"	14"	18¾"	12" x15"	1⅜"	S	1⅛"	S	344	359
4R48-1006	10	4	H	2½"	2"	2380.0	R-12	120	25⅞"	16 9/16"	17 13/16"	12" x15"	1⅜"	S	1⅛"	S	377	395
4R48-1506	15	4	H	2½"	2"	2380.0	R-22	120	25⅞"	16 9/16"	17 13/16"	12" x15"	1⅜"	S	1⅛"	S	388	406
6R48-1506	15	6	H	2½"	2"	3580.0	R-12	144	28⅞"	17⅝"	19 1/16"	12" x15"	2⅛"	S	1⅜"	S	425	445
4R48-2006	20	4	H	2½"	2"	2380.0	R-22	120	25⅞"	16 9/16"	17 13/16"	12" x15"	1⅜"	S	1⅛"	S	388	406
6R48-2006	20	6	H	2½"	2"	3580.0	R-12	144	28⅞"	17⅝"	19 1/16"	12" x15"	2⅛"	S	1⅜"	S	425	445
6R48-2506	25	6	H	2½"	2"	3580.0	R-22	144	28⅞"	17⅝"	19 1/16"	12" x15"	2⅛"	S	1⅜"	S	455	473
6R48-3006	30	6	H	2½"	2"	3580.0	R-22	144	28⅞"	17⅝"	19 1/16"	12" x15"	2⅛"	S	1⅜"	S	453	473

*Note, the entire line from 2 H.P. through 30 H.P. has only three different sets of mounting centers.



Write for complete Copelametic motor-compressor specifications. Request Bulletin number 5907.

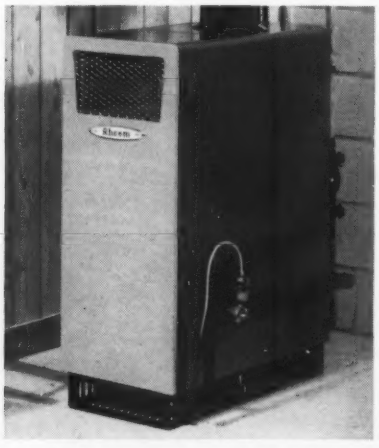
SINCE 1918 **Copeland** REFRIGERATION CORPORATION, Sidney, Ohio

Manufacturers of performance-proved motor-compressors and condensing units for air conditioning and refrigeration

PARTS and PRODUCTS

PACKAGED BOILER

For hydronic heating systems, this packaged gas-fired boiler has all controls and components enclosed and the circulating pump mounted at the



rear of the boiler to facilitate its operation with floor or ceiling panel heating or zone control. Wet-base design of the boiler gives advantages in efficiency and permissible installation on combustible floors. Foil-faced spun glass insulation, 1½-in. thick, fills all air space between boiler and jacket.

Made for hot water systems only, it is available in four sizes, ranging from 46,500 to 113,300 Btu/hr output. In addition to packaged units, it is available in knock-down units of 46,500 to 180,000 Btu/hr output.

Rheem Manufacturing Company, 7600 S. Kedzie Ave., Chicago 52, Ill.

THREE REFRIGERATORS

Three additions to the 1960 line of refrigerators are an electric two-door, freezer on the top model; an electric with a freezer compartment on the bottom; and a two-door gas unit. Each has an automatic, built-in ice cube server that provides ice cubes by the glass or bucket.

Norge Div, Borg-Warner Corporation, Merchandise Mart Plaza, Chicago 54, Illinois.

ELECTRIC FURNACE

Available with 81,840 Btu/hr output, the Type 319 can be adapted easily to central air conditioning by placing a cooling coil directly into the casing without any changes in the furnace or plenum arrangement.

Included in the cooling section are built-in coil hangers and drain pan, eliminating the need for a cooling coil cabinet. Other standard equipment includes a built-in filter rack and filters. Resilient-mounted blower motor has a variable speed sheave and V-belt drive.

Four 6 kw heating elements are energized and de-energized by a four-stage sequencer control to provide modulated heat. Horizontal design of the furnace lends itself to suspension in a crawl space, basement, utility room or attic. The unit may be operated with or without a duct system.

Mueller Climatrol Div, Worthington Corporation, 2005 W. Oklahoma Ave., Milwaukee 1, Wisc.

BLOWER CONDENSER

Designated LSBC, this low silhouette air-cooled unit was designed for use in rooftop locations, its shape allowing installation on most roofs with a safe lb/sq ft loading, eliminating re-



inforcing of roof members necessary to support other type units.

Models are available from 5 to 53½ ton and direct air upward, keeping noise at a minimum.

Dunham-Bush, Inc., 170 South St., West Hartford, Conn.

LIQUID LEVEL CONTROL

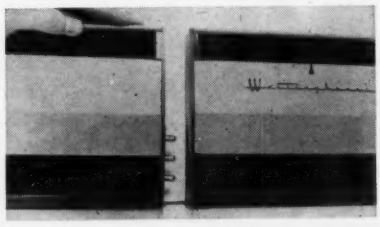
Continuing to follow the true water level regardless of ice formed in the tank, Model A-101 assures proper switch actuations to pump control or alarm circuits. A complete package unit, it installs in outdoor water storage tanks by means of bracket mounting, with a submersible switch housing unaffected by humid atmosphere or complete immersion of the head itself. Vapor-proof construction of the mercury switch assembly protects it against freezing weather by preventing the entrance of atmospheric moisture and resultant frost build-up. A resistance heater keeps the housing interior warm.

An immersion heater in the tube around the displacers in the unit prevents freezing of the water in the tube, despite ice formation on the surface of water in the tank, enabling the displacers to monitor the true level of tank water. Displacers are set to maintain a constant 36-in. differential. If desired, max differential can be shortened in 6-in. increments between 36-in. max and 6-in. min.

Magnetrol, Inc., 2110 S. Marshall Blvd., Chicago 23, Ill.

BASEBOARD HEATING

Featuring the use of modular plug-in sections (shown) that cut installation



time considerably, this line of baseboard electric heating equipment provides the same output, 250 watt/linear ft, as previous models while being more compact. Electrical connections are required at one point only, in the control section. Additional sections are installed by plugging in to the control section through a concealed three-pronged connection. This double-male grounded plug provides continuous flow of power to each section.

Because of the flexibility provided by the plug-in feature, one standard two-ft length is available, eliminating the need for a number of baseboard sizes. In addition, the line includes a corner section which can be used to provide continuous right angle connection for either an inside or outside corner.

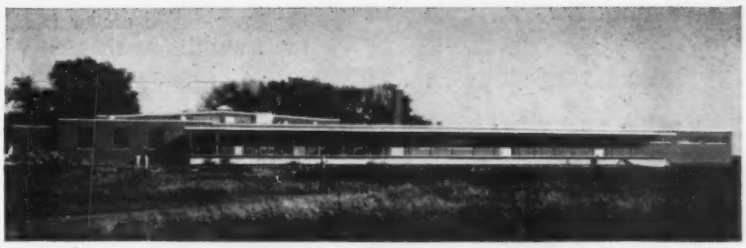
Thermostatic adjustment over a range from 50 to 90 F is possible, and each section is available with a choice of 120, 208, 240 and 277 volt.

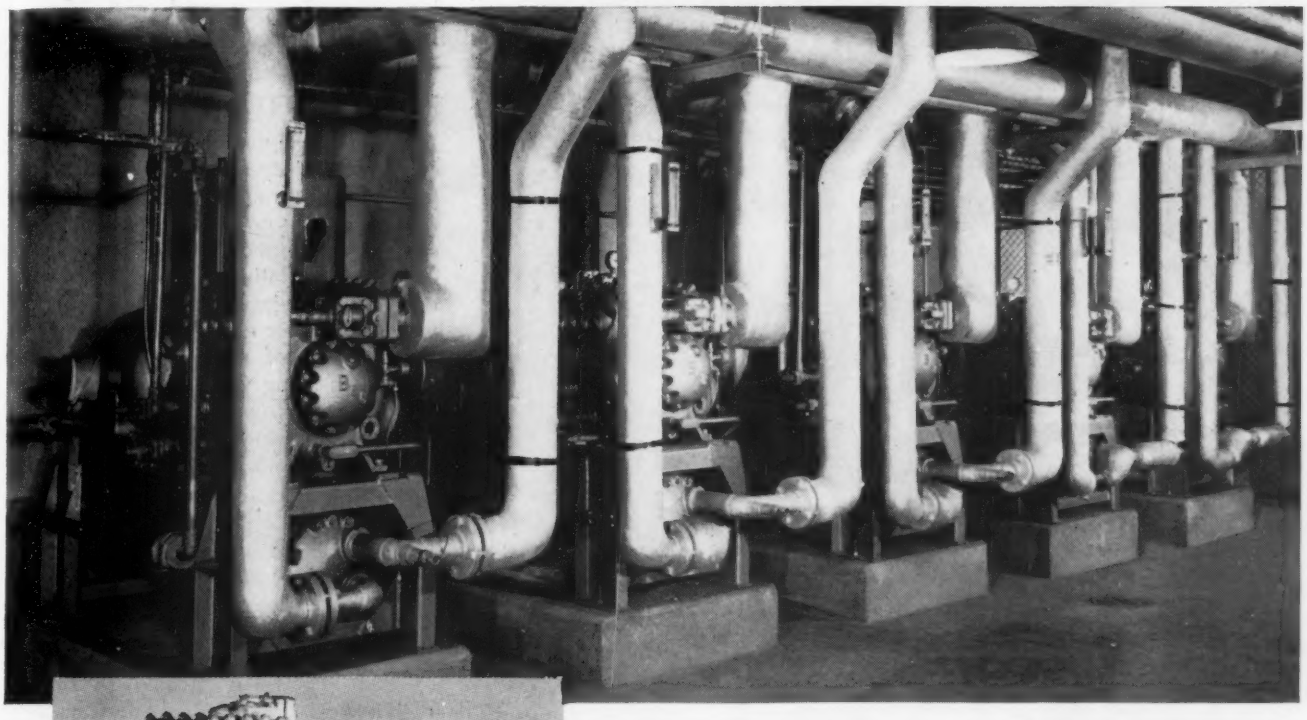
Westinghouse Electric Corporation, P. O. Box 2099, Pittsburgh 30, Pa.

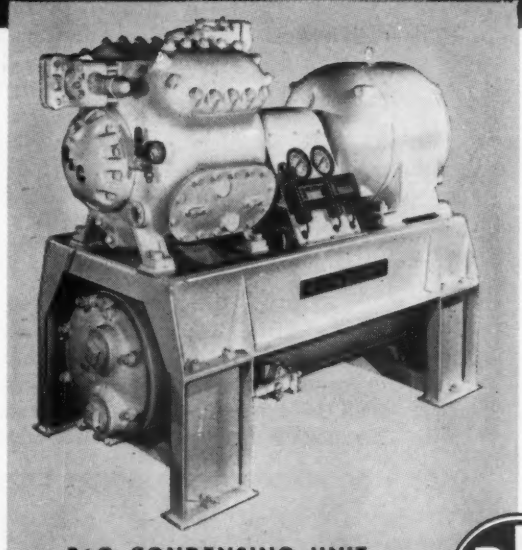
CLOSED-CIRCUIT COOLER

Making possible control of condensing pressure in a narrow range, this evaporative water cooler may be used with single or multiple compressor systems. Purified water is circulated through a closed system, cited as eliminating scale or other deposits in the condensers. Water returning to

B&G® CONDENSING UNITS SELECTED FOR KANKAKEE, ILLINOIS, STATE HOSPITAL







B&G CONDENSING UNIT
An achievement in design, featuring interchangeable vital parts. 7½ through 150 tons. Performs with effortless smoothness, but with rugged brute strength available when required.

This modern institution was constructed in 1959 under the direct control of the Division of Architects and Engineers of the State of Illinois. The consulting engineers for the mechanical equipment were E. R. Gritschke & Associates, Chicago, Illinois. Burge Ice Machine Co., Chicago, Illinois, made the installation. The B&G low temperature equipment selected to meet the exacting food preservation requirements of this installation was three 25 HP and two 20 HP low temperature Condensing Units.

The B&G Compressor is a notable advance in refrigeration engineering. It is distinguished by *quieter operation —less vibration!* All Compressors have *one* bore diameter —a few interchangeable parts will service all units, reducing maintenance problems.

Remember, too, that *all* major parts of B&G "package" units are made and guaranteed by Bell & Gossett Company. This "plus" design feature means greater dependability—greater value per dollar.

BELL & GOSSETT
COMPANY
Dept. GC-64, Morton Grove, Illinois
Canadian Licensee: S. A. Armstrong, Ltd.
1400 O'Connor Drive, Toronto 16, Ontario

A COMPLETE LINE OF REFRIGERATION AND AIR CONDITIONING "PACKAGES" AND COMPONENTS



B&G Evaporators



B&G Centrifugal Pumps



B&G Condensers



B&G Package Liquid Coolers

Men who know quality best... choose Calgon®!



Yes, men who have tried them all choose Calgon Products. Products such as Calgon Algaecide or Calgon Biocide RP. Both provide a fast, sure kill. Safe and easy to use, these products will help keep heat transfer rates high, help cooling water systems operate at top efficiency.

Calgon Algaecide and Calgon Biocide RP are two more Quality Calgon Products available from your Refrigeration Wholesaler. Ask him about all of them.

For free booklet on how to solve water problems, write:

CALGON COMPANY
HAGAN BUILDING, PITTSBURGH 30, PA.

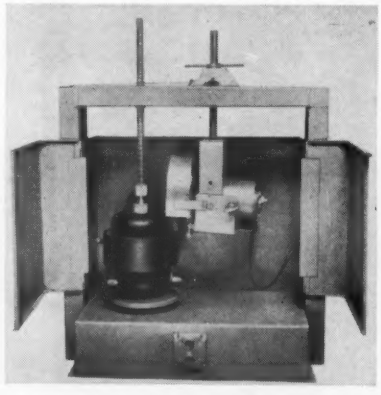
DIVISION OF HAGAN
CHEMICALS & CONTROLS, INC.

the evaporative cooler is at temperatures well below those at which hard scale will form on the tube bundle of the cooler.

Recold Corporation, 7250 E. Slauson Ave., Los Angeles 22, Calif.

COMPRESSOR OPENER

Designed to automatically open any hermetic compressor up to 14-in. diam, whether round, oval or irregular in shape, off or on center, top or side weld, the Junior Model Hermetic Compressor Opener requires 6.5 amp,

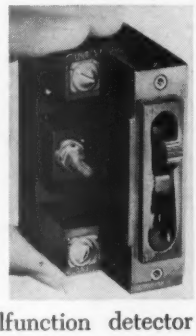


115 volt, 50 or 60 cycle current. A turn table with clamp can be used to re-weld opened compressors.

Frankell Manufacturing Company, Inc., 862 Newark Ave., Jersey City 6, New Jersey.

MANUAL POWER SWITCH

Electrically tripped by almost any type of power from a remotely located control or safety device, this product is an adaptation of the manufacturer's hydraulic-magnetic circuit breaker, but with the breaker contacts electrically isolated from the coil. Consequently, a limit control, timer, malfunction detector or overload condition in one circuit can cause tripping in another, interlocked control circuit.



The new interlock has an interrupting capacity of 2000 amp at 125 volt ac and is available with either a current or voltage-sensing coil.

Heinemann Electric Company, 799 Plum St., Trenton 2, N. J.

EXPLOSION-PROOF UNITS

Explosion-proof interiors are now offered in nine refrigerator models, to safeguard storage of volatile liquids in chemical, hospital, experimental, testing and atomic laboratories and similar areas. Ranging from one to 45 cu ft in size, these units are available with white enamel or stainless steel exteriors. Interiors are made explosion-proof by eliminating interior mechanism and lights; anything that could cause a spark. Controls are located outside the units and a safety-engineered coil is utilized.

Nor-Lake, Inc., Second and Elm, Hudson, Wisc.

LOAD LIMITING RELAY

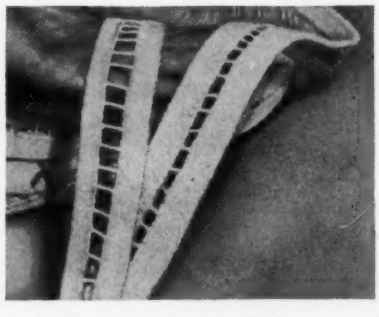
Installed in the pneumatic control circuit of centrifugal refrigeration compressors and responding to motor current, this relay protects against motor overload. Limiting the opening of the capacity regulating inlet valves or dampers to maintain a predetermined maximum motor current regardless of the demands of other controllers, it is cited as being valuable in preventing damage during the "start-up" period and following prolonged or overnight shutdowns, common instances of overloading.

Designed to operate at any current between three and seven amp, it can be applied to motors of any size when used with a properly selected current transformer. The secondary winding of the transformer energizes the coil of the R-27 relay, which in turn activates a conventional pneumatic relay to vary the output pressure in inverse proportion to the current. Maximum motor current is established by an integral set point adjustment.

Johnson Service Company, 507 E. Michigan St., Milwaukee 1, Wisc.

ASBESTOS GASKET TAPE

For industrial usages requiring a uniform gasketing that fits around bolts or studs to form an efficient double seal, this tape eliminates the necessity for making two separate gasket appli-



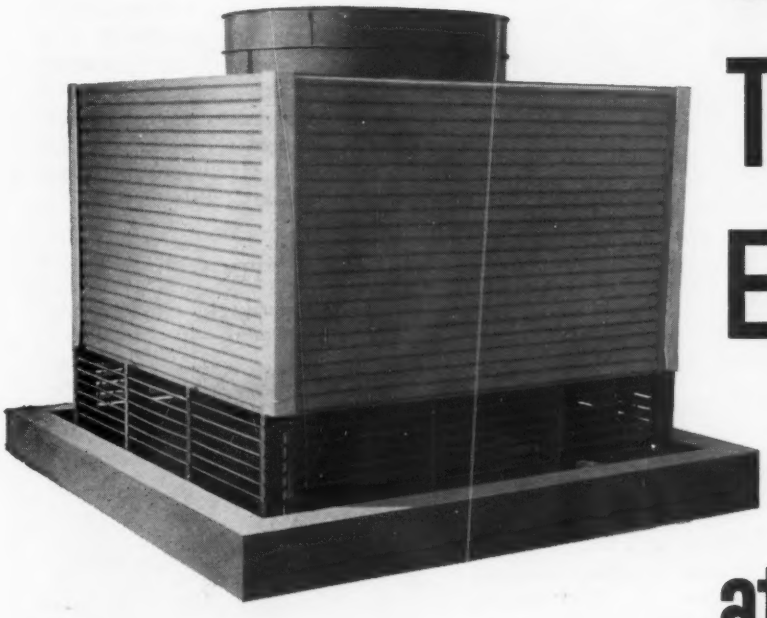
cations on either side of bolts or studs or to perforate broad gasketing before use.

Three types are available: plain wire inserted folded tape with an open lattice, or bolt space, center (Style 746); plain wire inserted tape

FLUOR

OVER 40 YEARS OF COOLING TOWER EXPERIENCE

* Since 1919 Fluor has been building cooling towers throughout the world.
(An average of one new industrial or commercial cooling tower is erected by Fluor every three days.)



Ask for our brochure that shows why Fluor Towers mean more efficient operation.

at your service *

Fluor
PRODUCTS COMPANY

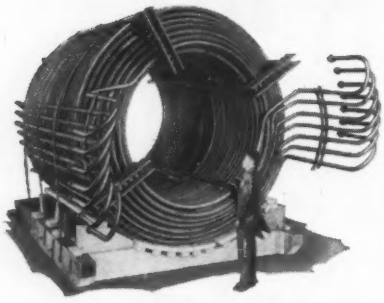
AIR CONDITIONING AND REFRIGERATION COOLING TOWERS

A division of The FLUOR CORPORATION, Ltd.

GENERAL OFFICES:
SANTA ROSA, CALIFORNIA

REMPE
Heat Transfer Equipment

PIPE COILS

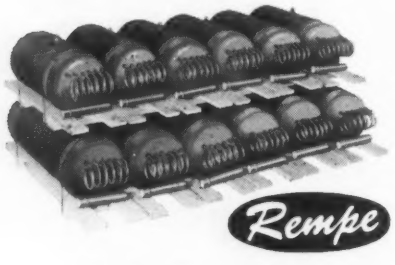


No Problem too Complicated for Rempe Engineers . . .

Complicated assemblies or production runs of Coils or Bends from any type of pipe or tubing can be designed to your requirements. Multiple spiral coil illustrated consists of seven separate circuits of carbon steel tube, electric welded at intermediate joints — Weight 22,000 lbs.

LARGE OR SMALL
WE MAKE THEM ALL

CASCADE CONDENSERS



For Low Temperature Refrigeration Systems

Ideally suited for all low temperature work. Illustration shows shipment of 12"x60" Cascades—sizes available from 6" to 30" diameters. Refrigerant vapor condenses in shell. Internal fin coil carries a second refrigerant. Also suitable for low temperature Glycol chilling down to minus 100° F.



Engineering Data Book
Pipe Coil and Fin Coil Designs. Heat Transfer Coefficients. Get a copy for your library.

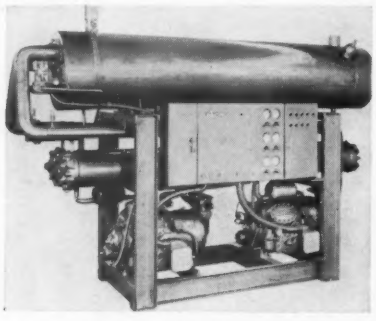
REMPE COMPANY
362 N. Sacramento Blvd. • Chicago 12, Ill.

woven flat to desired dimensions and bolt space openings (Style 738) and plain woven non-metallic tape (Style 748) similar to Style 738. Shown is the wide lattice type for large bolts. **Union Asbestos & Rubber Company, 1111 W. Perry St., Bloomington, Ill.**

WATER CHILLERS

Packaged units featuring twin hermetic compressors with individual motors for long life and stand-by protection of refrigeration and air conditioning equipment are now offered.

Designated Model HHD, the new line of 40 to 250-ton chillers supplies

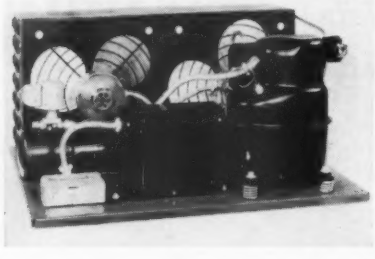


a means of equalizing wear in two-compressor systems as well as providing the added protection of two motors, either of which will keep the system in operation in the event one motor fails. Quite compact, the models range in size from 115¾ x 30 x 70⅜ in. for the 40-ton unit to 160⅞ x 41 x 104 for the 250-ton.
Acme Industries, Inc., 600 N. Mechanic St., Jackson, Mich.

CONDENSING UNIT

Release of a two-hp, Refrigerant 12 model suited for high back pressure applications such as water chillers, bulk milk coolers or air conditioning expands this line of air-cooled condensing units.

Featured is a dual voltage liquid line solenoid valve that is factory



mounted as an integral part of the unit, facilitating use of the pump-down cycle which controls the accumulation of liquid refrigerant in the crankcase.

Eliminating the necessity for a starter or across the line contactor is a heavy duty pressure control, and a dome mounted inherent overload protector is cited as insuring maximum protection to the compressor motor under widely varying operating conditions.

Model BRYH200T, here shown, is designed for 230 volt, 60 cycle, single phase operation.
Bendix-Westinghouse Automotive Air Brake Company, Evansville Div, 950 E. Virginia St., Evansville 11, Ind.

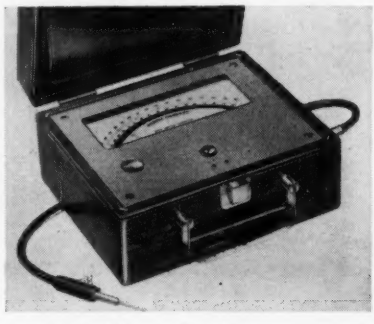
MOTOR CONTROL CENTERS

With capacity from 200 to 2000 amp for voltages from 110 to 600, these centers are used to control electrical loads such as motors, lighting, welding and heating in industrial plants and commercial buildings.

Available either as fusible or circuit breaker combination units, the control centers consist of two or more starters fed from a common bus and are often attached to transformers or switchgear to form a unit substation. Substations may be purchased as a complete package or as individual units. All control compartments of like size are interchangeable anywhere in the control panel.
Allis-Chalmers Manufacturing Company, Milwaukee 1, Wisc.

PORTABLE PYROMETER

Intended primarily to measure temperatures between —40 and 200 F,



this portable indicating pyrometer may be used with a selection of interchangeable thermocouples for various temperature measurements. Two scales or arcs, with 1 F per scale div, afford readability to the nearest ½ F.
Illinois Testing Laboratories, Inc., 420 N. LaSalle St., Chicago 10, Ill.

LOCKING METHOD

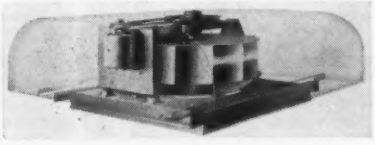
To prevent stress and pull between fabric and metal on flexible duct connectors from ripping the fabric, this manufacturer has produced a locking method. Designated Steel Grip, it consists of pre-attaching metal edges to fabric being locked into position in the metal-to-material-to-metal construction of the company's connectors. Combined with machine punching of

metal edges, the method is cited as providing a virtually foolproof locking action.

Elgen Manufacturing Corporation, 32-49 Gale Ave., Long Island City, N. Y.

ROOF VENTILATORS

Typical of the roof-hugging characteristics of the CKV ventilators, one model of which is shown here, the 9 x 9-ft weatherproof housing of the largest standard size model is only two ft in height. In addition to a wide

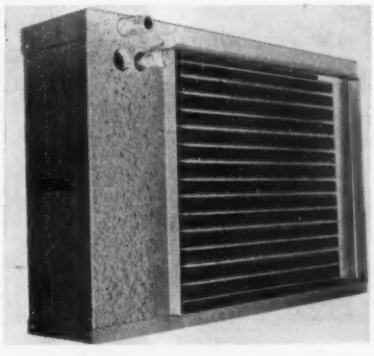


range of standard sizes with job-matched ball bearing motors, the manufacturer offers engineering assistance on modifications for unusual applications.

Hirschman-Pohle Company, Inc., Le Roy, N. Y.

RESIDENTIAL EVAPORATOR

Available in five sizes, having 2, 3, 4, 5 and 7½-ton capacities, the Model BH-2 is designed for installation in horizontal runs of duct work either in new or existing systems. An insulated cabinet and double drain pan



prevent sweating and the valve is mounted inside.

Features of the unit, which is shown here, are Neoprene coated insulation, a large access panel, inside space for expansion valve, duct flanges on both sides, air flow in either direction, circuiting suitable for either Refrigerant 12 or 22 and all sizes UL listed.

Bohn Aluminum & Brass Corporation, Danville Div, Danville, Ill.

GAS-FIRED FURNACES

With the exception of the smallest model, this entire line has been engineered for central year-round air conditioning. Adaptation to cooling is made possible through addition of a "cooling package"—a cabinet containing the cooling coil placed on top of the furnace and a compressor assembly placed outdoors.

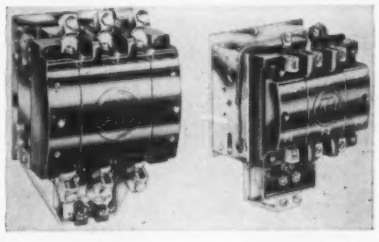
Type 144/145 units are 57 in. high, have a width of 14½, 18 or 24 in. and a depth of 25-3/16 in., and may be installed in basement, utility room or closet.

Mueller Climatrol Div, Worthington Corporation, 2005 W. Oklahoma Ave., Milwaukee 1, Wisc.

CONTACTORS

Supplied in Nema Sizes zero through five, with two, three or four poles, these mechanically held contactors supplement this manufacturer's other lines of magnetic motor controls, featuring the same small size, light weight, straight-through front wiring and other advantages.

Type CRA-MH contactors are electrically operated switches that are



closed by the momentary energization of a coil, and then held in the closed position by a mechanical latch instead of the electrical holding circuit usually employed.

To provide convenient remote-control operation, these instruments are equipped with a second coil. When this is momentarily energized by a push button, float or pressure switch, the mechanical latch is released, letting the contacts open through the action of gravity assisted by compression spring action. If desired, coil clearing contacts can be furnished to take both coils out of the control circuit immediately, if it is energized by a maintained contact device.

Arrow-Hart & Hegeman Electric Company, 103 Hawthorn St., Hartford 6, Conn.

SLIDING GATE SEATS

Available for regulators and control valves for ¼ through 3-in. sizes, these low flow sliding gate seats come in any capacity to suit individual requirements. For example, the 1¼-in. body size can have capacities of 1¼, 1, ¾, ½, ⅜ or ¼ in., as required. Low flow seats are used where initial requirements are for a low flow but later needs are for high flows, strength of full line size valves is needed but low flow is required, and to replace seats in an oversized valve body. Seats are



They said it couldn't be done... but Calgon® did it

—made a powdered acid that is Economical – Safe – Effective

Yes, where economy is the prime consideration when you are cleaning scale from a cooling water system, don't accept *one* without the other *two*. Calgon Condenser Cleaner has *all three*—it's *safe*, it's *economical* and it's *effective!*

Calgon Condenser Cleaner is one of the Quality Calgon Products available from your Refrigeration Wholesaler. Ask about all of them.

For free booklet on how to solve water problems, write:

CALGON COMPANY
HAGAN BUILDING, PITTSBURGH 30, PA.

DIVISION OF HAGAN
CHEMICALS & CONTROLS, INC.

Your nearest authorized RANCO wholesaler is listed here

See the Ranco wholesaler nearest you for your control requirements. Consult your telephone or city directory for his address. The Ranco line includes temperature and pressure controls for commercial and domestic refrigeration and air conditioning, reversing valves for heat pumps, and refrigeration motor relays. Controls for additional applications are constantly being added to the Ranco line.

(Wholesalers list as of January 18, 1960)

ALABAMA

Birmingham
Budlock Refrig. Supply Co., Inc.
Refrigeration Supplies Distributor
Wittichen Supply Company
Dothan
Hand Supply Company
Huntsville
Budlock Refrig. Supply Co., Inc.
Mobile
The Enochs Sales Company
Harris Supply Co., Inc.
Refrigeration Supply Co., Inc.
Montgomery
Nolin-McInnis, Inc.
R & H Supply Company
Teague Hardware Company

ALASKA

Anchorage
Homer's Wholesale Refrigeration

ARIZONA

Phoenix
Arizona Refrig. Supplies, Inc.
Authorized Supply Co. of Arizona
Refrigeration Supplies Distributor
State Equipment & Supply, Inc.
Tucson
Arizona Refrig. Supplies, Inc.
Authorized Supply Co. of Arizona
Yuma
Arizona Refrig. Supplies, Inc.

ARKANSAS

Fayetteville
Central Supply Company
Fort Smith
Central Supply Company
N. O. Nelson Co. of Fort Smith
Little Rock
N. O. Nelson Co. of Arkansas
Refrig. & Electric Supply Co.
Texarkana
Interstate Elec. Co.
of Texarkana, Inc.

CALIFORNIA

Bakersfield
Kern Refrigeration Supply, Inc.
Refrigeration Supplies Distributor
Berkeley
Rauch & Monroe
El Centro
Allied Refrig. Suppliers, Inc.
Refrigeration Supplies Distributor
Fresno
California Refrigerator Company
Devlin-Drew Company
Thermal Products, Inc.
Long Beach
L. B. Marsh Allied Refrig. Co.
Mutual Supply Company
Los Angeles
Air Cold Sales, Inc. (2)
Arrow-Risco Inc.
Authorized Supply Corporation
Brea Supply Company
George T. Hall Company
Pacific Metals Co., Ltd.
Refrigeration Service, Inc.
Refrigeration Supplies Distributor
Thermal Products, Inc.
North Hollywood
Arrow-Risco Inc.
Oakland
California Refrigerator Company
Hinshaw Supply Company
William Wurzbach Company
Palm Springs
Allied Refrig. Suppliers, Inc.
Riverside
Refrigeration Supplies Distributor
Sacramento
Acme Supply Co., Inc.
Associated Refrig. & Equip. Co.
Hinshaw Supply Company
Santa Barbara
Lear Supply Company
San Bernardino
L. B. Marsh Allied Refrigeration
Valley Refrigeration Supply Co.
San Diego
Allied Refrig. Suppliers, Inc.
Phillips Refrigeration Supplies
Refrigeration Supplies Distributor
San Francisco
California Refrigerator Company
Hinshaw Supply Company
Pacific Metals Co., Ltd.
Refrig. & Power Specialties Co.
San Gabriel
Arrow-Risco, Inc.
San Jose
A. G. Pond Company
William Wurzbach Company
Stockton
Refrig. & Power Specialties Co.

COLORADO

Denver
McCombs Supply Company
Refrig. Dist. Corp. of Colorado
Pueblo
J. F. Dammann Supply Company

CONNECTICUT

Bridgeport
Parsons Bros. Inc.
Hartford
The N. W. Day Supply Company
Melchior, Armstrong, Dessau Co.
Joseph Simons Company
New Haven
Resco, Inc.
South Norwalk
Standard Supply of
Connecticut, Inc.

DISTRICT OF COLUMBIA

Washington, D. C.
Aireco Supply Inc.
Melchior, Armstrong, Dessau Co.
Refrigeration Supply Co., Inc.
Henry M. Sweeny Co., Inc.

DELAWARE

Wilmington
Greenberg Supply Company
United Refrigeration, Inc.
Wilmington Plbg. Supply Co., Inc.

FLORIDA

Daytona
R & R Supply Company
Ft. Lauderdale
Graves Broward Co., Inc.
O'Brian Associates Broward Div.
Gainesville
Baker Brothers, Inc.
Jacksonville
Baker Brothers, Inc. (2)
Bowen Refrig. Supplies, Inc.
Graves, Inc.
Noland Co., Inc.
Lakeland
Graves Bros. Refrig. Supplies
Miami
Ace Refrig. Supplies, Inc.
Berner-Pease Co., Inc.
Bowen Refrig. Supplies, Inc.
Graves Refrigeration Co., Inc.
O'Brian Associates
Orlando
Baker Bros. Inc. of Orlando
R & R Supply Company, Inc.
Panama City
Remsco Incorporated
Pensacola
Cooling & Heating Supplies
Sarasota
Graves Bros. Refrig. Supplies, Inc.
St. Petersburg
Mote W. Baird & Son, Inc.
Graves Bros. Refrig. Supplies, Inc.
Tallahassee
Baker Bros. Inc. of Tallahassee
Tampa
Leo S. Bosarge Co. of Tampa
Bowen Refrig. Supplies, Inc.
Graves Bros. Refrig. Supplies, Inc.
Noland Company Inc.
West Palm Beach
Ace Refrig. Supplies, Inc.
Motor Parts & Equipment, Inc.
O'Brian Associates

GEORGIA

Albany
Graves Supply Corporation
Atlanta
The Harry Alter Company
Leo S. Bosarge Company
Bowen Refrig. Supplies, Inc.
Henry V. Dick & Co., Inc.
Graves Refrigeration, Inc.
Augusta
Graves Supply Co. of Augusta
Brunswick
Baker Brothers, Inc.
Columbus
Graves Supply Corporation
Grubbs Service Supply Co.
Hajoca Corporation
Macon
Graves Supply Co. of Macon
Savannah
Baker Brothers, Inc.
Coastal Supply Company
Valdosta
Baker Bros. Inc. of Tallahassee

HAWAII

Honolulu
J. W. Podmore & Sons Ltd.
Refrig. Service & Supply Co., Ltd.

IDAHO

Boise
Commercial Distributing Co.
Refrig. Dist. Corp.
Refrigerative Supply, Inc.

ILLINOIS

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Alton N. O. Nelson Company
Bloomington
Polar Supply Corporation
United States Electric Company
Chicago
Airo Supply Company Inc.
The Harry Alter Company (2)
Chase Supply Co., Inc. (4)
James B. Clow & Sons, Inc.
A. Gatz Supply Company
Fred C. Kramer Company
M. & L. Appliance Parts Supplies
Refrig. Supply Jobbers, Inc.
Decatur
Potter Supply Company
East St. Louis
Illinois Electric Works, Inc.
N. O. Nelson Company
Forest Park
The Harry Alter Company
Marion
Illinois Electric Works, Inc.
N. O. Nelson Co. of Marion
Melrose Park
Service Parts Company
Peoria
Marquette Equipment Company
Polar Supply Corporation
Quincy
Polar Supply Corporation
Rockford
Gustave A. Larson Company
Park Distributors, Inc.
Springfield
United Electric Company
Urbana
Rogers Refrig. Supply Company

INDIANA

Evansville
Budlock Refrig. Supply Co., Inc.
Fort Wayne
Central Supply Co.
F. H. Langsenkamp Company
Gary
Chase Supply Company
Indianapolis
Duncan Supply Co., Inc.
F. H. Langsenkamp Company (2)
Square Deal Supply Company
Lafayette
General Refrig. Supply Co., Inc.
Muncie
Duncan Supply Co., Inc.
South Bend
F. H. Langsenkamp Company
Valley Equipment Co., Inc.
Terre Haute
Budlock Refrig. Supply Co., Inc.

IOWA

Burlington
Pioneer Supply Company
Cedar Rapids
Thermal Company Inc.
Davenport
Republic Refrig. Wholesalers
White Refrig. Supply, Inc.
Des Moines
Dennis Supply Company
Tesdell Refrigeration Supply
Thermal Company, Inc.
White Refrig. Supply Co., Inc.
Dubuque
Gustave A. Larson Company
Sioux City
Dennis Refrig. Supply Company
National Refrig. Parts Company
Waterloo
Winterbottom Supply Company

KANSAS

Topeka
Refrig. Equipment Co., Inc.
Wichita
Howard Supply Company
Refrig. Equipment Co., Inc.
Superior Supply Company

KENTUCKY

Danville
United Service Co., Inc.
Frankfort
Frankfort United Service, Inc.
Harlan
United Service Co., Inc.
Lexington
Brock-McVey Refrig. Supply Co.
United Service Co., Inc.
London
United Automotive Service, Inc.
Louisville
S.W.H. Supply Co., Inc.
Williams & Company, Inc.
Mt. Sterling
Mt. Sterling United Service, Inc.
Paducah
Budlock Refrig. Supply Co., Inc.
N. O. Nelson Company
Richmond
United Auto Parts
Somerset
United Automotive Service Inc.

LOUISIANA

Baton Rouge
Acme Refrigeration
Atlas Refrig. Supplies, Inc.
Lafayette
Cooling & Heating Wholesalers
Solar Supply Co. of Lafayette, Inc.
Standard Brass & Mfg. Company
Lake Charles
Solar Supply, Inc.
Solar Supply of Lake Charles, Inc.
Monroe
Thermal Supply of Monroe, Inc.
New Orleans
Acme Refrig. Supplies, Inc.
Budlock Refrig. Supply Co., Inc.
Enoch Sales Co., Inc.
Mechanical Supply Company
Nola Sales Company Inc.
Solar Supply of New Orleans, Inc.
Standard Brass & Mfg. Company
Shreveport
Interstate Elec. Co. of Shreveport
Standard Brass & Mfg. Company
Thermal Supply of
Shreveport, Inc.

MAINE

Portland
A. E. Borden Company
J. Simons Company
Supply Distributors Corporation

MARYLAND

Baltimore
Baltimore Refrig. Supply Co.
Crown Refrig. Supply Company
Hajoca Corporation
Kleinman Brothers, Inc.
Melchior, Armstrong, Dessau Co.
Roche & Hull, Inc.
Hagerstown
Roche & Hull, Inc.
Salisbury
Roche & Hull, Inc.

MASSACHUSETTS

Boston
A. E. Borden Company, Inc.
N. W. Day Supply Co. of Mass.
Melchior, Armstrong, Dessau Co.
Supply Distributors Corporation
Springfield
C. P. Payson Company Inc.
Worcester
Standard Supply, Inc.

MICHIGAN

Alpena
J. George Fischer & Sons, Inc.
Detroit
Champine Refrig. Supplies (3)
Deke Jones Company
Lee Equipment Company
Riopelle Supply Company
Squire Supply Co., Inc.
Young Supply Company
Flint
Heating & Cooling
Wholesalers, Inc.
Lifsey Distributing Company
Grand Rapids
Heating & Cooling
Wholesalers, Inc.
Midwest Refrig. Supply Company
Highland Park
J. M. Oberc, Inc.
Jackson
J. Geo. Fischer & Sons, Inc.
Kalamazoo
Heating & Cooling
Wholesalers, Inc.
Lansing
Heating & Cooling
Wholesalers, Inc.
Pontiac
Young Supply Company
Port Huron
S & W Supply Company
Saginaw
J. Geo. Fischer & Sons, Inc.
Saginaw Distributors, Inc.

MINNESOTA

Duluth
Refrigeration Wholesalers, Inc.
Thermal Company Inc.
Minneapolis
Refrig. & Industrial Supply Co.
Tempcon, Inc.
Tem-trol Corporation
Thermal Company Inc.
St. Paul
Refrigeration Supply Co., Inc.
Thermal Company Inc. (2)

MISSISSIPPI

Gulfport
Paine Supply Co., Inc.
Jackson
Mississippi Refrig. Supply Co.
Paine Refrig. Supply Company
Plumbing Wholesale Company
Meridian
Motor Supply Co., Inc.
Pascagoula
Paine Supply Company
Tupelo
Paine Supply Corp. of Tupelo

MISSOURI

Cape Girardeau
N. O. Nelson Co.
of Cape Girardeau

Jefferson City
N. O. Nelson Co. of Jefferson City
Joplin
Joplin Supply Company
Kansas City
Forslund Pump & Mach. Corp.
Refrigeration Equipment Co.
Superior Supply Company
Springfield
Hoffman Supply Company
Thermal Supply Company
St. Joseph
H. Ehrlich & Sons Mfg. Co., Inc.
St. Louis
Authorized Refrig. Parts Co.
Mechanical Supply Co., Inc.
N. O. Nelson Administration Co.
Refrigeration Supplies, Inc.
R. E. Thompson Company (2)

MONTANA

Billings
Temperature Supply Company
Great Falls
Temperature Supply Company

NEBRASKA

Lincoln
Wickham Supply Co., Inc.
Omaha
Dennis Supply Co., Inc.
John Klich Refrig. Supply
Ruegg Supply Co., Inc.
White Refrig. Supply, Inc.

NEVADA

Las Vegas
L. B. Marsh Allied Refrigeration
Refrig. Supplies Distributor
Reno
Acme Supply Co., Inc.

NEW HAMPSHIRE

Manchester
Cobe & Foster Inc.

NEW JERSEY

Atlantic City
Atlantic City Auto Supply Co., Inc.
Avon-by-the-sea
Wallwork Bros.
Bridgeton
Hajoca Corporation
Camden
Fleck Bros. Co., Inc.
Hajoca Corporation
United Refrigeration, Inc.
Elizabeth
Abe Gruber & Co., Inc.
Hillside
Jay Levins, Inc.
Newark
Melchior, Armstrong, Dessau Co., Inc.
Tesco Distributors
Wallwork Bros.
New Brunswick
Tesco Distributors
Ocean Grove
Tesco Distributors
Passaic
M. Blazer and Son
Paterson
White & Shauger, Inc.
Ridgefield
Melchior, Armstrong, Dessau Co.
Trenton
Allied Elec. Appliance Parts, Inc.
Jaegers Sales & Supplies

NEW MEXICO

Albuquerque
Airco Supply Company
M & M Refrig. Supply
Yucca Wholesalers, Inc.

NEW YORK

Albany
Albany Garage, Inc.
R. D. Marshall & Co., Inc.
Binghampton
Meier Supply Company
Bronx
Peter Blasco Company
Schwartz Supply Company
Brooklyn
The Capson Company, Inc.
Coleman Electric Supply Co.
Excel Refrig. Supplies, Inc.
Halsey Supply Company
Melchior, Armstrong, Dessau Co.
Buffalo
Jordan Supply Company, Inc.
Melchior, Armstrong, Dessau Co., Inc.
Root, Neal and Company
Elmira
Brady Supply Corporation
Hicksville
Abco Refrig. Supply Company
Jamaica
Wholesale Distributors, Inc.
Kingston
Orange County Plbg. Supply Co.
Long Island City
Air Cond. Supply Co., Inc.
Middletown
Orange County Plbg. Supply Co.
Mount Vernon
Eastern Supply Company
Newburgh
Orange County Plbg. Supply Co.
New Hyde Park
The Capson Company, Inc.
New York
Abco Refrigeration Supply Co.
Aetna Supply Company
The Harry Alter Company
Albert Hofeld, Inc.
Melchior, Armstrong, Dessau Co.
Paramount Elec. Supply Co., Inc.
Reese & Long Refrig. Prod., Inc.
Wholesale Distributors Inc.
Port Jervis
Orange County Plbg. Supply Co.
Poughkeepsie
Swift Parts Supply
Rochester
Genesee Refrig. Supplies, Inc.
Nohle Refrigeration Supplies
Ontario Metal Supply, Inc.
Pfaudlers Refrig. Parts, Inc.
Syracuse
Empire Refrig. Supply Co., Inc.
Genesee Refrig. Supplies, Inc.
Melchior, Armstrong, Dessau Co.
Utica
Vaeth Electric Company
White Plains
Marco Refrig. Supply Corp.

NORTH CAROLINA

Asheville
Henry V. Dick & Co., Inc.
Hajoca Corporation
Charlotte
Bowen Refrig. Supplies, Inc.
Henry V. Dick & Co., Inc.
Durham
Hasco Inc.
Fayetteville
Hasco Inc.
Goldsboro
Womack Electronics Corporation
Greensboro
Hasco Inc.
Kinston
Noland Company Inc.
Raleigh
Henry V. Dick & Co., Inc.
Noland Company Inc.
Rocky Mount
Womack Radio Supply Co., Inc.
Wilmington
Henry V. Dick & Co., Inc.
Wilson
Noland Company, Inc.
Winston-Salem
Henry V. Dick & Co., Inc.
Hasco, Inc.

NORTH DAKOTA

Fargo
Refrigeration Supply Co., Inc.
Minot
Reeves Refrig. Heating Supply Co.

OHIO

Akron
Davey Sales Company
Refrigeration Supplies, Inc.
Canton
Refrig. Economics Co., Inc.
Cincinnati
Mason Supply Company
Mutual Mfg. & Supply Company
Radio, TV & Refrig. Supply, Inc.
Williams & Company, Inc.
Cleveland
Cleveland Hermetic & Supply, Inc.
Debes Refrigeration Supply Co.
Refrigeration Supplies, Inc.
Williams & Company
Columbus
Mason Supply Company
Williams & Company
Dayton
Allied Supply Co., Inc.
W. H. Kiefaber Company
Hamilton
Allied Supply Co., Inc.
Lima
Allied Supply Co., Inc.
Portsmouth
King & Irwin, Inc.
Springfield
Allied Supply Co.
Toledo
Heat & Power Engineering Co.
Williams & Company, Inc.
Youngstown
Refrigeration Supplies, Inc.

OKLAHOMA

Lawton
Jones-Newby Supply Co. of Okla. City
Muskogee
Jones-Newby Supply Co. of Tulsa. Inc.
Oklahoma City
Jones-Newby Supply Co. of Okla. City
Waugh Brothers Supply Co.
Tulsa
Jones-Newby Supply Co. of Tulsa Inc.
Palmer Supply Company
Waugh Bros. Supply Co., Inc.

OREGON

Eugene
Peerless Pacific Company
Refrigerative Supply, Inc.
Portland
Johnstone Supply Company
Pacific Appliance Parts
Peerless Pacific Co., Refrig. Div.
Refrig. & Power Specialties Co.
Refrigerative Supply, Inc.

PENNSYLVANIA

Allentown
Larson Supply Company
Altoona
Allen Supply Company
Ardmore
Hajoca Corporation
Bethlehem
Hajoca Corporation
Erie
Erie Refrigeration Supplies
Greensburg
Eastern Refrigeration Supply Co.
Harrisburg
The Bodwell Company, Inc.
Resco, Inc.
Philadelphia
Acar Supply Company
Allied Elec. Appliance Parts, Inc. (2)
M & E Refrig. Accessories Co.
Melchior, Armstrong, Dessau Co.
United Refrigeration, Inc. (2)
Victor Sales & Supply Co., Inc.
Pittsburgh
William M. Orr Co., Inc.
Pa. Industrial Supplies Company
Proie Brothers, Inc.
Williams & Company
Reading
Hajoca Corporation
Larson Supply Company
Scranton
Central Service Supply
Warminster
Allied Elec. Appliance Parts, Inc.
Wilkes-Barre
General Radio & Electronic Co.
Radio Service Company
Williamsport
General Radio & Electronic Co.

RHODE ISLAND

Providence
A. E. Borden Company
R. I. Refrig. Supply Co., Inc.

SOUTH CAROLINA

Charleston
Baker Brothers, Inc.
Noland Company, Inc.
Roberts Refrig. Supply Company
Columbia
Henry V. Dick & Co., Inc.
Noland Company, Inc.
Florence
Henry V. Dick & Co., Inc.
Greenville
Henry V. Dick & Co., Inc.
Graves Refrigeration, Inc.
Spartanburg
Noland Company, Inc.

SOUTH DAKOTA

Aberdeen
Tem-trol Corporation
Sioux Falls
Thermal Company, Inc.

TENNESSEE

Chattanooga
Noland Company, Inc.
Peglars, Inc.
Jackson
Southern Supply Company
Johnson City
Refrigeration Equipment Co.
Kingsport
Refrigeration Equipment Co.
Knoxville
Knoxville Refrig. Supply Co.
Leinart Engineering Company
Memphis
Budlock Refrig. Supply Company
N. O. Nelson Company
United Refrig. Supply Company
Nashville
Ed's Supply Company, Inc.
The Starr Company
J. B. Thomas Company, Inc.

TEXAS

Abilene
Refrig. Supply & Electric Co.
Amarillo
Jones-Newby of Texas, Inc.
Waugh Brothers Supply Co.
Austin
Hub Supply Company, Inc.
Milstead Company
Thermal Supply of Austin, Inc.
Beaumont
Johnson Supply
Solar Supply of Beaumont, Inc.
Standard Brass & Mfg. Company
Thermal Supply of Beaumont, Inc.
Corpus Christi
Airtrol Supply Inc.
International, Inc.
Thermal Supply of Corpus Christi, Inc.
Dallas
The Harry Alter Company, Inc.
Barbeck Refrig. Supply Co.
Climate Supply Company
Electrical Supply Corporation
The Electromotive Corporation
Snell Refrigeration Supply
El Paso
M & M Refrigeration Supply
Fort Worth
Koldaire Supply Co., Inc.
Tersco, Incorporated
Galveston
Thermal Supply of Galveston, Inc.
Harlingen
Hoctor Supply, Inc.
International, Incorporated
Thermal Supply of Harlingen, Inc.
Houston
Bowen Refrig. Supplies, Inc.
Johnson Supply
Lingo Company, Inc.
Standard Brass & Mfg. Company
Thermal Supply, Inc.
Thermal Supply of Houston, Inc.
Longview
Barbeck Refrig. Supply Co., Inc.
Lubbock
Tersco, Incorporated
Waugh Bros. Supply Co., Inc.
McAllen
Thermal Supply of McAllen, Inc.
Midland
Midosa Supply Company, Inc.
Odessa
Tersco, Incorporated
Port Arthur
Standard Brass & Mfg. Company
San Angelo
Central Electric Company
San Antonio
International, Inc.
Service Supply San Antonio Div.
Thermal Supply of San Antonio, Inc.
Westbrook Company
Sherman
Electrical Supply Corporation
Texarkana
Thermal Supply of Texarkana, Inc.
Tyler
Climate Supply Company
Victoria
Service Supply of Victoria, Inc.
Thermal Supply of Victoria, Inc.
Waco
Hub Supply Company, Inc.
Tersco, Incorporated
Wichita Falls
Barbeck Refrig. Supply Company

UTAH

Salt Lake City
Commercial Distributing Co.
Johnstone Supply Company
Pacific Metals Co., Ltd.
Refrigeration Distributors Corp.

VERMONT

Burlington
Blodgett Supply Company, Inc.

VIRGINIA

Bristol
Refrigeration Equipment Co.
Southern Refrigeration Corp.
Charlottesville
Refrigeration Supply Co.
Danville
Womack Radio Supply Co., Inc.
Hampton
Peninsula Refrig. Suppliers, Inc.
Lynchburg
Southern Refrigeration Corp.
Newport News
Noland Company, Inc.
Norfolk
Hajoca Corporation
Noland Company, Inc.
Refrigeration Suppliers, Inc.
Richmond
Air Conditioning Suppliers, Inc.
Hajoca Corporation
Refrigeration Supply Company
Roanoke
Noland Company, Inc.
Southern Refrigeration Corp.

WASHINGTON

Seattle
Refrig. & Power Specialties Co.
Refrigeration Wholesalers, Inc.
Refrigerative Supply, Inc.
Thermal Supply Co., Inc.
Spokane
Refrigerative Supply, Inc.
Wakefield Supply Company
Tacoma
Refrig. & Power Specialties Co.
Yakima
Thermal Supply Company

WEST VIRGINIA

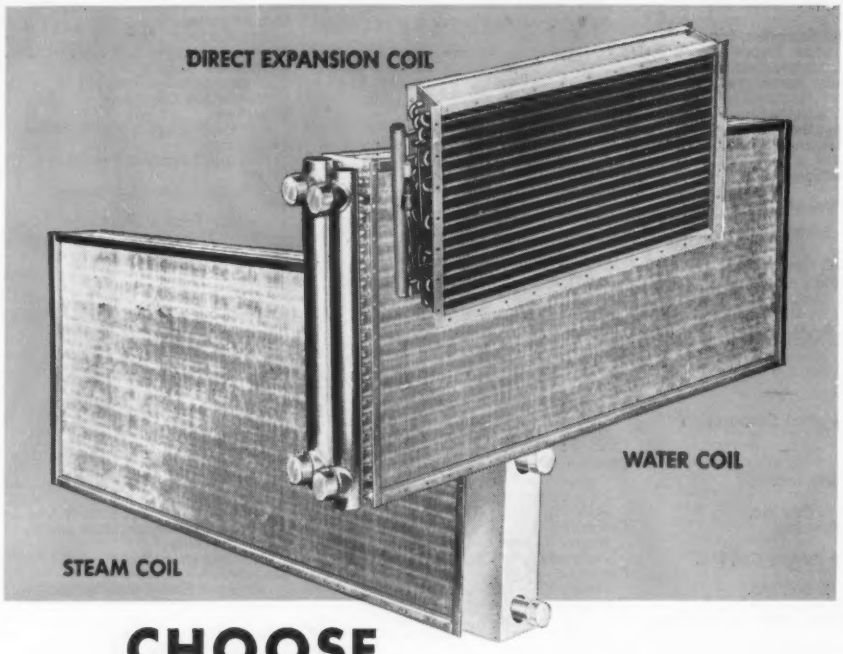
Charleston
Amick & Miller, Inc.
Hiner Refrigeration Supply Co.
Mason Supply Company
Huntington
King & Irwin
Mechanical Refrig. Supply, Inc.
Wheeling
Mason Supply Company

WISCONSIN

Eau Claire
Gustave A. Larson Company
Green Bay
Gustave A. Larson Company
Wisconsin Refrig. Supply Co.
Kenosha
Gustave A. Larson Company
LaCrosse
W. A. Roosevelt Company
Madison
Automatic Temperature Supplies, Inc.
BTU Equipment & Supply Corp.
Gustave A. Larson Company
Milwaukee
Gustave A. Larson Company
Refrigeration Parts Co., Inc.
Thermal Company, Inc.
Vincent Refrig. & Heating Supply
Wisconsin Refrigeration Supply Co.
Oshkosh
Gustave A. Larson Company
Wausau
Gustave A. Larson Company

Form No. 1761—1-60-5C

Ranco
INCORPORATED
COLUMBUS 1, OHIO



CHOOSE BOHN KNOWN-CAPACITY COILS

ALL BOHN COILS are ruggedly built...

- Die-formed plate-type aluminum fins... from 4 to 14 per inch...with self-spacing collars completely covering the tubes. Permanent, tight, metal-to-metal fin-tube bond.
- Heavy-gauge casings die-formed from galvanized steel.
- Headers of heavy-wall seamless copper tube with heavy die-formed end caps. High pressure tested at 320 psig. minimum air pressure under warm water.
- Tested and rated according to ASRE-ASHAE standard 33-58.

IN ADDITION...

DIRECT EXPANSION COIL — Type DE, insures equal distribution of refrigerant with brass pressure-type distributors;

WATER COIL — in Types WH, WF, and WD, is drainable in every type;

STEAM COIL — in Types S, NFS, and NFO, has condensing tubes pitched in casing a minimum of ⅛" per foot of tube length, as well as orificed steam supply tubes, and coil tubes floating free within coil casing to prevent stress and strain on tubes and joints... maximum operating pressure 200 psig. at 400° F.

A Memo from BOHN:

We are one of the largest manufacturers of specially designed evaporators and condensers for Original Equipment Manufacturers of refrigeration and air conditioning units and systems.

For full information, call or write . . .

BOHN *Buy the known line... the BOHN line*

Aluminum & Brass Corporation

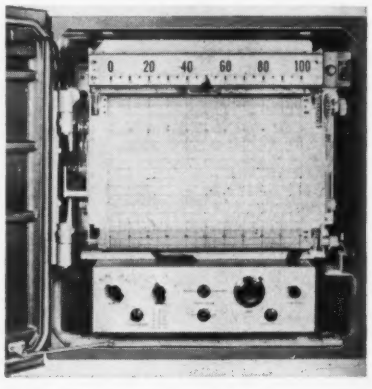
Danville Division • Danville, Illinois

self-lapping and self-cleaning in operation and give tight shut-off.
OPW - Jordan Corporation, 6013 Wiehe Rd., Cincinnati 13, Ohio.

LABORATORY RECORDER

Basically a Dynamaster wide-strip potentiometer recorder, this instrument has been especially adapted to laboratory requirements, lending itself readily to measuring such variables as pressure, temperature, motion, flow, density, pH and electric power.

Special input signal selection switches and span adjustments pro-



vide maximum flexibility with selection of millivolt, volt, microamp or milliamp input and ranges of 0-2, 0-5, 0-10, 0-25 and 0-50 offered. An adjustable zero and pushbutton standardization are standard, with automatic standardization optional.

Attachments offered are: dual or multi-speed (six speeds) chart drive, time pen, chart-footage indicator, manual chart rewind, manual or electric pen-lifters and re-transmitting slidewires.
Bristol Company, Waterbury 20, Conn.

LEAK DETECTOR

A non-flammable, non-corrosive liquid, Detect-A-Leak, when applied to pressure lines, tanks, pressure vessels or wherever leakage is possible, forms large bubbles which remain intact until the danger spot can be marked for repair. When used on gas lines or other high pressure containers of flammable materials, there is no need to reduce the pressure.
Flamort Chemical Company, 746 Natoma St., San Francisco 3, Calif.

ALUMINUM DIFFUSER

An extruded aluminum grille, the Curtainaire, has been added to this line of air distribution products. Available in widths from 1½ to 15 in. and in lengths up to 12 ft in one piece, the diffuser is manufactured in two

Climate by Chrysler



2 Park Avenue, New York City. Consulting Engineers: Sears and Kopf; Mechanical Contractor: Kennedy-Scheidel-Young, Inc.; Electrical Contractor: Theodore Kaish, Inc.

Chrysler Air Conditioning tailored to tenant needs installed a floor at a time in 27-story building

During the past five years, scores of Chrysler air conditioners have been installed at 2 Park Avenue, New York City. What has been one of the longest air conditioning jobs in history has also been one of the most successful.

By handling this 27-story building zone by zone and floor by floor, about 1400 tons of Chrysler equipment have been installed . . . with an absolute minimum of inconvenience to tenants. As tenants move in or renew leases, they are consulted as to exact air conditioning requirements. Each then gets the system best suited to his needs.

This unusual method is flexible—Chrysler can supply packaged units, chillers or room units as needs demand. And it is economical—all air conditioning equipment taps into central electrical, water and air connections which serve the entire building.

Chrysler engineers worked closely with the consulting engineer and contractor during the advance planning of this complex air conditioning problem. They will be as happy to cooperate with you. For information on their services and Chrysler Air Conditioning equipment, write today.

CHRYSLER
AIRTEMP

Airtemp Division, Chrysler Corporation, Dept. Z-30, Dayton 1, Ohio
In Canada: Therm-O-Rite Products, Ltd., Toronto, Ontario

100 percent air recirculation? you're crazy!



Total recirculation isn't the answer in every case but it gives the best purity and the lowest cost for many ventilating situations. The point is, Barnebey-Cheney activated charcoal air purification *lets you design for total recirculation* of inside air, and save substantially in both initial investment for heating and cooling equipment and operating costs.

A typical well designed system uses outside air in the spring and fall for cooling and 100% recirculation with activated charcoal purification in the summer and winter. In most buildings normal infiltration and the opening of doors provides plenty of oxygen. Pressurizing of the building can be incorporated if desired. Write for Bulletin T-321. Barnebey-Cheney, Columbus 19, Ohio.

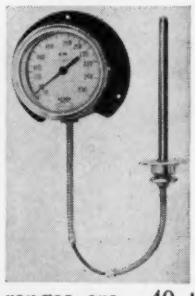
activated charcoal air purification

Barnebey Cheney

standard frame widths, with friction springs for floor or sill installation or safety catches for wall or ceiling installations. The bars are obtainable in zero or 15 deg settings and are spaced so as to be pencilproof. Accessories available are opposed blade damper, straightening vanes and blanking baffles.
Carnes Corporation, Verona, Wisc.

DIAL THERMOMETERS

Insertion type, vapor actuated dial thermometers for duct installations feature ease of reading and accuracy throughout the entire working range, a progressively graduated scale for use in the upper range and all brass fittings.



Case design permits installation for adjustable angle, rigid or remote reading. Standard ranges are −40 to 65, −20 to 120, zero to 100, 30 to 150, 40 to 220, 60 to 250 and 100 to 350 F.
Weksler Instruments Corporation, 195 E. Merrick Rd., Freeport, Long Island, New York.

REFRIGERATOR-FREEZERS

Three models have been introduced by this manufacturer for 1960, providing the buyer with a choice of freezer location: at the top, on the bottom or side-by-side with the fresh food compartment. Completely automatic defrosting systems may be installed flush-to-the-wall or built-in.

Models are an 18-cu ft unit with 6-cu ft vertical freezer on the left, 14-cu ft with 108-lb freezer on the bottom and 14.4-cu ft with 130-lb freezer at the top.
American Motors Corporation, Kelvinator Div, Detroit 32, Mich.

PACKAGED CONDITIONERS

Five small economy models have been added to the basic PAC line of packaged air conditioners by this manufacturer. Of the evaporative condenser type, they are in capacities of 25, 30, 40, 50 and 60 ton. All feature smaller outside casings than previous models and include multiple compressor units. They are equipped with 10- and 15-hp compressors which through a two-step thermostat handle partial loads by cutting in or out. Four-step units with two thermostats are also available.
Acme Industries, Inc., Jackson, Mich.



every inch a VIKING!

At Viking, we realize that the production of highest-quality thin-wall copper tube depends as much on the skill and knowledge of the workers as much as it does upon machines. Accordingly, every man on the Viking production team has been carefully trained for his part in the job of producing thin-wall tube. He knows exactly what he is doing.

He is dedicated to the Viking proposition that nothing but the best will do — whether it is meeting a particular specification for tubing — or an emergency schedule for delivery.

Viking sales and engineering personnel are always ready to discuss with you any special copper tube requirements you may have. They know they can take your order, in complete confidence that all your specifications will be met — exactly. That's because everyone engaged in the manufacture of Viking copper tube adheres unswervingly to the idea: it *must* be every inch — a Viking!

VIKING

COPPER TUBE CO.

CLEVELAND 10, OHIO

THINKING OF ENTERING THE ELECTRIC HEAT FIELD?

Then you should know...





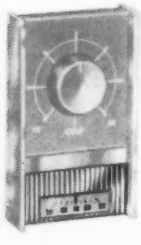
TYPE 1A61
World's Largest Seller



TYPE 1A65
Elegant New Companion

The Industry's Standard of Beauty And Performance

IN ELECTRIC HEAT THERMOSTATS... WHITE-RODGERS IS THE LEADER!



Easily attached thermometer now available at slight additional cost.

More than 50 electric heat equipment manufacturers put their brand names on White-Rodgers 'stats . . . using several times more than all other makes combined.

If your organization is considering electric heat, as a possible new product, we at White-Rodgers offer you the experience gained through leadership to assist you with any control problem you may encounter. Our technical staff is at your service . . . just write us.

WR

WHITE-RODGERS

ST. LOUIS 6, MISSOURI TORONTO 8, CANADA

you can both HEAT and COOL with these large capacity

McQuay SEASONMAKERS

These extremely popular large capacity McQuay Seasonmakers enable you to provide year 'round comfort at any desired temperature level . . . heated, filtered air in cold months, and cooled, dehumidified, filtered air in warm months . . . when used with a hot or chilled central water supply.

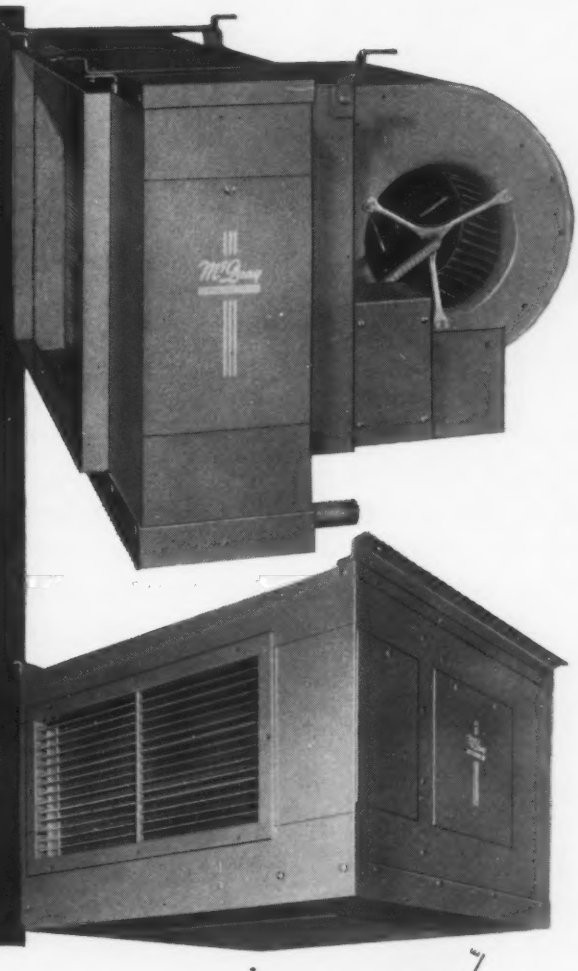
They are particularly designed for commercial or residential applications where a direct air distribution system is necessary, or for use in medium to large areas requiring 2, 3 or 5 tons capacity. Units are also available for refrigerant operation.

You'll like the 3-speed, quiet operation and the double drain pan with ½" insulation for protection against sweating and the auxiliary drain pan to catch condensate from the control or shutoff valve. In fact, you'll like everything about these McQuay Seasonmakers. For complete information, see your McQuay representative, or write McQuay, Inc., 1606 Broadway Street N. E., Minneapolis 13, Minnesota.

2-3-5 TON CAPACITIES

3-SPEED QUIET OPERATION

3-ROW COILS FOR MAXIMUM HEAT TRANSFER



Write for catalog No. 721 for complete selection and capacity information.

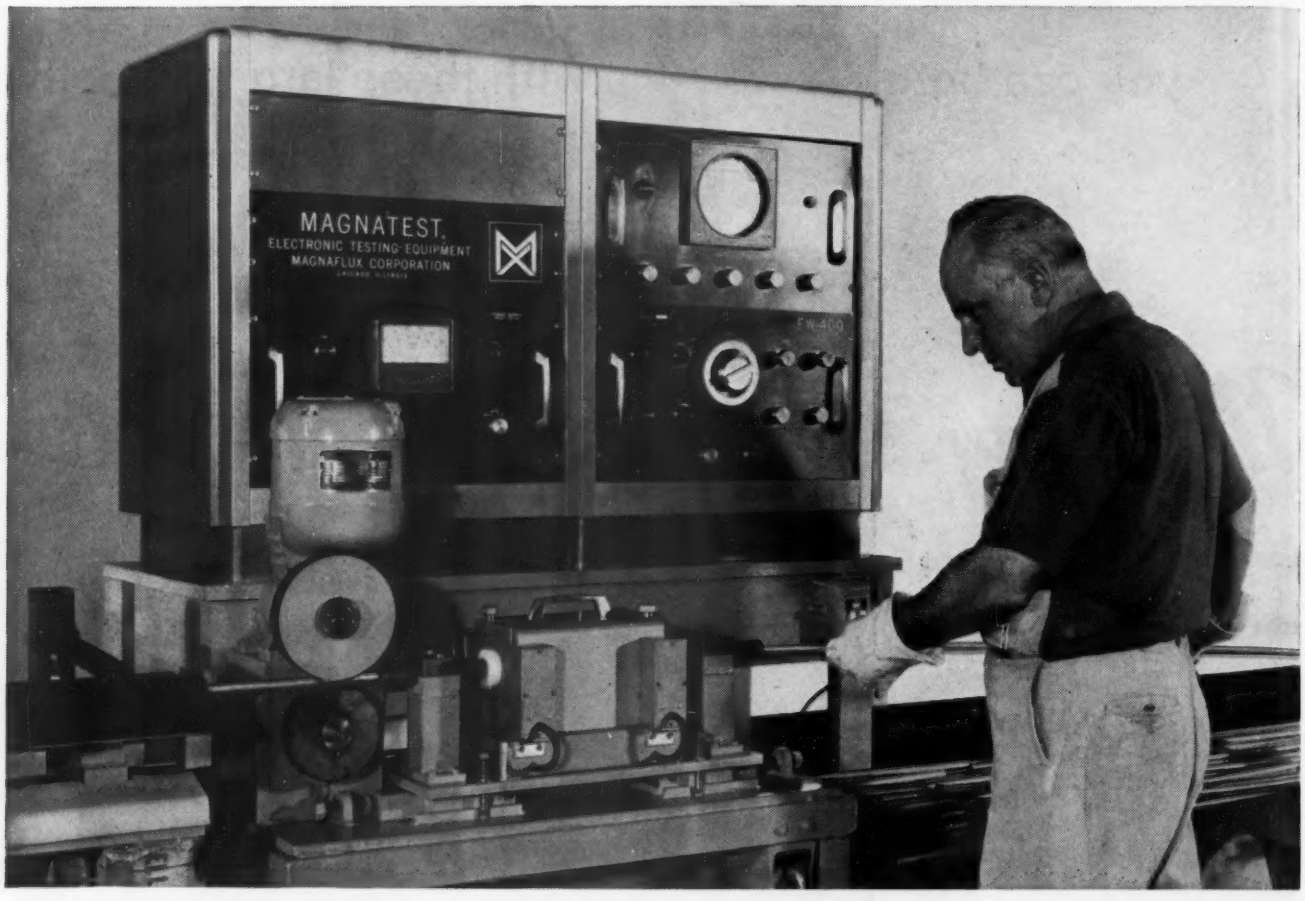
McQuay Means Quality

McQuay INC.

AIR CONDITIONING • HEATING • REFRIGERATION



Why eddy-current testing gives you consistent soundness in Anaconda thin-wall tube



Many years of experience with eddy-current testing have enabled Anaconda to develop meaningful inspection standards

Through its long association with the air conditioning and refrigeration industry, Anaconda knows the importance of top quality in thin-wall copper tube. From billet to finished tube, quality-conscious practices control production. Critical and realistic standards govern inspections.

Eddy-current testing is one of the important reasons why Anaconda thin-wall copper tube consistently meets the industry's rigid quality requirements. Anaconda pioneered in developing the application of this valuable tool to the inspection of copper tube, during 10 years of research on electronic testing.

This extensive development work—involving the hydrostatic expansion of literally thousands of tubes—has enabled Anaconda to establish practical eddy-current inspection levels for meaningful inspection standards.

Tubes that do not meet these standards in the eddy-current test are *automatically* segregated—so that there is no chance for human error.

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ASHRAE JOURNAL
OFFICIAL PUBLICATION
MARCH 1960

Dallas Does It

True to its own traditions, as well as those of the Lone Star State, Dallas provided an unexpectedly large attendance for both the ASHRAE Semiannual Meeting and for the Second Southwest Heating and Air Conditioning Exposition. When the last registrant for the meeting had checked in, the score was 3294. Attendance at the Memorial Auditorium passed 10,000 by a comfortable margin; 7135 individuals registered there. Statistically, and in every other way, the Meeting was a success.

With a program so arranged that all technical sessions and symposiums were held in the mornings of February 1-4, afternoons and most evenings were left for exposition attendance without conflicts with committee meetings or social events.

All individual sessions were well attended and considerable discussion, prepared and extemporaneous, enlivened a number of them. Among key topics was the psychrometric chart, subject of a symposium and a subsequent analytical session when the objective of a letter-page size, single color, open line, 1½-2 per cent employable freedom-from-error accuracy and Society-imprinted sheet became definitive. Again, the use of plastics, as discussed and later brought to a question-and-answer period in which representatives of the Society of the Plastics Industry presided, was the subject of the Domestic Refrigerator Engineering Symposium.

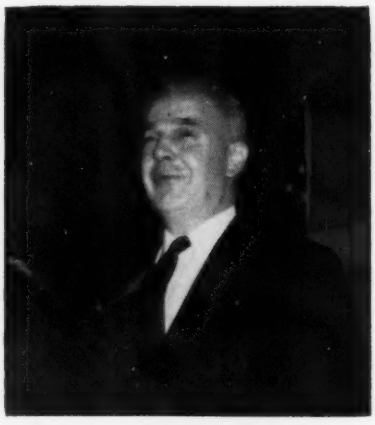
Cold storage rooms – Results of a study based upon the hypothesis that floor insulation of cold storage rooms at 35 F should be provided in sufficient thickness to prevent a heat gain per sq ft through the floor from exceeding the heat gain per sq ft through the wall were reported by Professors J. D. Hovanesian, H. F. Pfost and C. W. Hall of Pennsylvania State University, Kansas State University and Michigan State University, respectively. Their findings indicated that heat gain through a unit area of floor is generally less than that through the same area of wall or ceiling. The ratio of heat loss of the wall vs. heat loss of the floor

Attendance that exceeded 3000 by a comfortable margin and signing up for numerous social events kept the registration area busy throughout each day





When Arthur J. Hess relinquished the Presidency to Dan D. Wile. To Past President Hess, a weather-monitoring temperature-humidity-pressure instrument assembly, a humorously large glass and a Society emblem with diamond as well as a Certificate of Appreciation, here being presented



W. J. Collins, Jr., Director of Region VIII, welcomed the members and their guests

was found to be especially high with large storage rooms.

Considering the ratio of wall and ceiling area compared to floor area, the total floor heat flow becomes small in relation to total wall and ceiling flow. The use of perimeter insulation did not reduce heat flow appreciably. In conclusion, the authors stated that they "seriously question use of perimeter or floor insulation as a means to reduce refrigeration costs in 35 F storage rooms. Insulating the floor appears to be an unnecessary initial cost in the construction of such storages."

Heat exchangers – Determining the optimum core geometry of heat exchangers is of considerable importance, maintained Donald G. Rich, Carrier Corp., but it is complicated by the fact that the rate of heat transfer and friction energy per unit surface area may vary over wide ranges for commonly used surface configurations. Again, what may be optimum in surface area may not be optimum in weight, volume and cost. According to the author, the coil rating factor offers numerous advantages as a basis for comparing heat exchangers–Comparisons under identical heat transfer and friction performance conditions can be made. Effects of tube side heat transfer coefficient and metal thermal resistance can be included easily. Surface area or any other parameter which is directly proportional to the surface area can be optimized.

Results can be interpreted quantitatively. The method is not dependent upon the optimization of the parameter. Graphical comparisons of surface areas, weights and volumes using a single abscissa are possible. An additional curve for each heat exchanger velocity provides both face velocity and face area comparison. And, finally, the lines of constant friction power per unit surface area easily are included.

Frost formation – Professor W. F. Stoecker of the University of Illinois explained that when frost is accumulating on pipe coils that are cooling air by natural convection, the first deposit increases the coefficient of heat transfer due to the roughening of the surfaces which gives a greater area for heat transfer. As frost deposit thickens, the coefficient of heat transfer remains constant due to the increase in external surface area and increase in conductivity of frost as it becomes more dense.

These effects compensate for the increased resistance to heat transfer caused by the thickening of the frost deposit. The coefficient of heat transfer begins to diminish when the thickness exceeds 0.5 to 0.6 in. and drops off rapidly when the passages for air flow become blocked. The recommended point at which defrost should appear, according to the author, is when the frost bridges over from pipe to pipe and blocks the air flow. The presence of neighboring pipes in the coil and radiation from the pipes increase the coefficient of heat transfer over that of a single tube and also cause accelerated rate of deposit of frost on the side of the tubes.

With liquid oxygen – Mass diffusion of water vapor through air is important in the transfer of heat to surfaces maintained at extremely low temperatures, asserted J. L. Loper of the Western Company. It is his contention that frost affords effective thermal insulation after the lapse of approximately one hour. While frost

initially increases the heat transfer rate because of the influence of mass diffusion, as it forms it provides increasing resistance to the flow of heat as compared to the constant rate obtained in dry air.

Because of the more rapid build-up of frost in more humid air, frost formation at high humidity conditions affords better insulation after a certain interval than formations at lower humidities. Wind plays an important role initially but as frost accumulates the wall becomes less sensitive to convection effects. As stated by author Loper, formation of frost on a cold wall is analogous to the condensation mechanism since a phase change occurs, giving a high rate of heat transfer. The condensate flows off, giving a relatively small resistance to the transfer of energy conduction through the condensate layer remaining on the surface.

Frost builds up adding resistance with time, but at a decreasing rate due to the decreasing differential between the partial pressure of water vapor in the ambient air and the partial pressure corresponding to the air-frost interface, reducing the energy transferred by convection, radiation and mass diffusion as all are functions of surface temperature. Frost formation tends to bring about a nearly steady state condition and a heat transfer rate whose magnitude is essentially independent of wind velocity and relative humidity.

Noise reduction — "Lack of a uniform method for testing the acoustical characteristics of prefabricated package attenuators and a scarcity of quantitative acoustical data of any nature have combined to keep such units from being widely used," commented Norman Doelling of Bolt, Beranek and Newman.* He stated that the percentage of open area and length are the significant variables used to estimate approximate noise reduction of package attenuators. Thus, increasing low-frequency noise reduction either increases space requirements or increases static pressure losses. While important at high frequencies, gross geometry has negligible effect at low frequencies. Scaling noise reduction with length is not an accurate procedure. Noise reduction of a series combination of units cannot be found from the noise reductions of the individual units. According to the author, there is a great need for standards which, in addition to definitions and techniques to describe noise reduction characteristics, should include ways of dealing with noise generation characteristics of package attenuators and the effects of high speed air flow on noise reduction. Although not important in low pressure systems, these characteristics may assume importance in high pressure, high velocity systems.

With turning vanes — In air conditioning and especially high velocity systems, the noise generation level of system components must be considered in order to predict accurately the levels in the occupied spaces, advanced William F. Kerka who reported upon a study at the ASHRAE Cleveland Research Laboratory to determine as a function of frequency both the noise generation and sound attenuation in elbows with turning vanes.*

It was found that no-flow attenuation in elbows with turning vanes is dependent upon the elbow size and angle. Noise generation levels of vaned elbows are significant and in general may be only about 10 db less than the level of the fan in the system. For vaned elbows of the same size but of different angles, noise generation level in the low and mid-frequency range is about the same for a given air velocity. In the low frequencies of vaned elbows of the same angle, the noise generation level increased markedly as the size increased.

* A condensed version of this paper, "How Effective Are Packaged Noise Attenuators for Air Conditioning Systems?" appeared in the February issue of the ASHRAE JOURNAL, pp. 46-50.

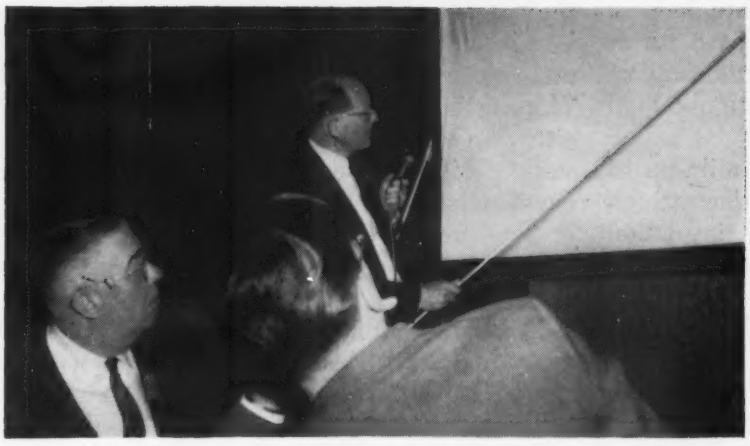
* See pp. 49-54, this issue of the JOURNAL.



S. J. Williams, Chairman of the Program Committee, was Chairman of the First Technical Session. Here shown, with J. L. Loper, speaking

Those who presented papers at the First Technical Session included J. D. Hovanesian, D. G. Rich and W. F. Stoecker







W. E. Fontaine was Chairman at the Second Technical Session and, as shown, attends as Burgess Jennings presents the paper the latter co-authored with C. M. Humphreys and J. T. Baker. Right, Norman Doelling's topic was noise reduction

Noise generation level of vaned elbows of different aspect ratios is nearly the same in the mid-frequencies but increases in the lower frequencies and to a lesser extent in high frequencies as the aspect ratio increases.

Chimney draft – As part of a study originating at the National Research Council of Canada by W. G. Brown and C. Wachmann, (formerly of the Council) records for draft, efficiency and friction loss obtained with masonry chimneys of three different heights were compared with previous records and with calculations based on model tests. A. G. Wilson presented the paper.

The authors discovered that non-isothermal friction losses are far greater than isothermal losses due to natural convection effects; the effect of low wind speeds over the chimney top was found to be considerable. Earlier methods of design which assumed that friction losses in the vertical flue were the same as for smooth pipes in isothermal flow are likely to be in error.

The authors suggested that a more thorough study of natural convection effects will be needed before a complete design method for chimneys can be proposed. This study pointed out that wind can be treated separately from steady-state performance and that it can be studied using models.

Steam flow – C. M. Humphreys, J. T. Baker and B. H. Jennings of the ASHRAE Research Laboratory discussed results of an investigation on saturated steam flow in copper tubing.* They explained that the theory of flow of fluids in pipes has been studied intensively for many years and that pressure loss resulting from fluid flow was early observed to be proportional to pipe length, inversely proportional to pipe diameter and to vary closely as the square of the mean fluid velocity.

For each size of pipe or tubing there is a critical steam velocity above which condensation is picked up and carried through the branch with the steam instead of flowing along the bottom of the line to the drip. This study indicated that critical steam velocity increases with increasing tube size. For tube sizes from ⅜ to 1½ in. this occurred at a pressure loss of approximately 0.25 psi per 100 ft length.

Re-evaluation of pipe sizes – A program was initiated at the ASHRAE Research Laboratory to bring up-to-date and more in line with the present theory of fluid flow all of the information on steam and condensate flow which appears in the ASHRAE GUIDE. William F. Kerka, who presented this paper by title only, stated that there is still a need for the study of condensate flow in return piping. He sees the need for re-evaluating the condensate flow tables in future GUIDES as new information, based on more advanced theories of fluid flow, becomes available.

Compressors vs. motors – Erik H. Jensen of Westinghouse Electric Corp. reported on experiments which showed that pulsating loads have a definite effect on motor performance, at least with respect to currents, and that mechanical details of design and application of the compressor and motor can affect the motor performance substantially.* Mr. Jensen pointed out that in compressor design the lowest current drawn for a given load will be obtained with pumping impulses equally spaced. There is a possibility of adverse effects from changes to lighter materials in the moving parts. Larger moments of inertia reduce the current; higher speeds have the same effect.

Motors should be sized as closely as pos-

* A condensed version of this paper, "Critical Velocity Emphasized in New Study of Saturated Steam Flow in Copper Tubing" appeared in the February issue of the ASHRAE JOURNAL, pp. 59-64.

* A condensed version of this paper, "What Effects Do Compressor Characteristics Have on Motor Performance?" appeared in the February issue of the ASHRAE JOURNAL, pp. 51-54.



Vice President Walter A. Grant was in charge of the Third Technical Session where W. L. McGrath (seated) was Chairman. Speakers included E. H. Jensen (at the blackboard), D. F. Miller, B. W. Hatten, A. L. Brody and C. M. Humphreys, who presented the ASHRAE Laboratory paper of N. Ozisik and L. F. Schutrum



sible to the load and not oversized. High voltages will cause more adverse effects on currents on a pulsating load than on a steady load. It was shown that the current drawn by a compressor can be varied 10-25% for the same compressor capacity by variations in compressor design only. The author recommended that more work be done on the problem to show the effects more accurately, to determine how efficiency is affected and to find better criteria for motor arrangements.

Acoustics of mufflers — Mufflers used in refrigeration compressors to reduce the pulsating pressures and flows in intake and discharge lines must be carefully analyzed and designed to avoid coincidences of acoustic resonances with excitation frequencies and to obtain satisfactory attenuation of the higher frequency components of the alternating flow, asserted D. F. Miller, Westinghouse Research Laboratories and B. W. Hatten, Westinghouse Electric Corp., who presented an analytical method for accurately predicting muffler response up to fairly high frequencies. A method of obtaining muffler response curves by means of digital computation is based on successive use of the undamped one-dimensional wave equation to represent each tube element in the muffler system.

Wave effects were an important factor in determining the attenuation at the higher frequencies. Steady-state response curves were found to be useful in analyzing mufflers since they allow interpretation of resonance behavior whether these resonances are excited or not by the actual pulse type input from the valve. These curves also allow comparison of muffler designs, making it possible to explore quickly the effects of various muffler geometries.

Odor control by charcoal — An evaluation of activated charcoal as an odor adsorbing agent in forced convection units, undertaken by Aaron L. Brody, Jess W. Thomas and Lois Lafeber of the Whirlpool Corp. Research Laboratories, revealed that granular activated coconut shell charcoal, used under both extreme and simulated household conditions, significantly reduced refrigerator odor and odor transfer between foods. The most efficient odor decreases were found when activated charcoal was placed in the path of forced air for cooling; activated charcoal out of the path of forced air was less efficient, as was activated charcoal in a cabinet without forced air, however all three are significantly superior in odor removal performance to controls with no adsorbent present.

Drapes and windows — The following factors were brought out in a research project on the effects of drapes on heat flow through a sunlit glass, carried out at the ASHRAE Research



F. Y. Carter introduced R. S. Buchanan as Chairman of the Fourth Technical Session where speakers were R. Burggraaf (shown) and H. C. S. Thom, C. M. Humphreys (who presented the paper co-authored with Walter Koch and Burgess Jennings) and G. O. Handegord

Laboratory by Necati Ozisik and L. F. Schutrum—Solar heat gain through a single glass with a drape can be obtained by multiplying the incident solar radiation on the glass by the K factor (ratio of the solar heat gain through a glass and a drape combination to the incident of solar radiation on the glass surface). Solar reflectance of a material on the glass side largely determines the solar heat gain.

A material with a high solar reflectance on the glass side excludes more solar heat than a material with a low reflectance. Effectiveness of glass and drape combinations in excluding solar heat can be compared directly by their K factors. During this study, for the draperies tested with regular plate glass, solar heat gains ranged from about 45 to 75% of those for unshaded glass with white (60% reflectance) to dark green (15% reflectance) drapes respectively.

In Alaska — No information has been available relating to solar heat gain values in Alaska for locations farther north than 50 deg. North Latitude even though the most populated region lies between the 56 deg. and 66 deg. North Latitude lines. Robert Burggraaf of Harmon & Beckett, Inc. compiled summer outdoor design conditions for three major Alaskan cities (Anchorage, Fairbanks and Juneau). He asserted that with the data he presented to supplement that given in the GUIDE it is possible to make cooling load calculations for these cities.

Weather design variables — In discussing a rational method of determining summer weather design data, H. C. S. Thom of the U. S. Weather Bureau stated that the load on air conditioning equipment involves a number of other factors besides weather conditions. Limiting his discussion to wet and dry bulb design values, Chief Climatologist Thom remarked that there must be some small probability of the system being unable to meet the load imposed by weather conditions. The selection of this probability is not a climatological problem but an engineering one and involves many factors such as economy, use and customer satisfaction. According to the author, the best that the climatologist can do is to furnish the engineer with a practical set of probability values from which he can make the correct selection for design.

Optimum comfort — A comprehensive program of studies on the effects of environmental conditions on human comfort, productivity and learning rate, to supplement the ASHRAE Comfort Chart for Still Air, appearing in the 1959 GUIDE, was carried out under the supervision of Dr. Walter Koch, Burgess H. Jennings and C. M. Humphreys at the ASHRAE Research Laboratory. Covered were the responses of subjects to temperature and humidity with the other variables of the environment being so adjusted as to have minimum effect.

Lines of equal thermal sensations for continued occupancy were determined which are applicable to sedentary (inactive) individuals, lightly clothed in still-air conditions, in a uniform radiant environment with the temperature of the surroundings maintained approximately equal to the air temperature. The line of optimum comfort for both winter and summer is approximately straight and ranges from 77.6 F at 30% relative humidity to 76.5 F at 85% relative humidity. The comfort of the occupants was found to be only slightly dependent on humidity.

Proposed humidity standard — Conforming to definitions included within the Final Report of the International Joint Committee on Psychrometric Data, no practical form of humidity measuring instrument can be used to provide a fundamental humidity standard other than by the production of a standard atmosphere, C. E. Till, formerly of the National Research Council of Canada and G. O. Handegord of the Council explained. The outcome of their studies was that an atmosphere producer, using recirculation of moist air in a closed system, provided a practical fundamental standard for humidity which is consistent in principle with the definitions given in the Report.

The range of humidities of which the atmosphere producer is capable is limited in the present arrangement to dew points between −20 and 70 F. The lower limit of the dry bulb temperature is 10 F. According to the authors, the atmosphere producer has potentialities as a reference standard of humidity for broad applications.



At the Domestic Refrigerator Engineering Symposium, L. K. Warrick presiding, Paul Lawrenz (seated) was keynoter, W. E. Brown (below) and Dale Amos told of paths to improved specification engineering and use of plastics





Questions met answers by the SPI panel of experts at the Domestic Refrigerator Engineering Symposium



PLASTICS IN REFRIGERATORS

Although plastics materials have been used for many years by the domestic refrigerator and freezer and domestic air conditioner industries in a variety of parts, their use in these applications is still questioned by some customers, L. K. Warrick, Acting Chairman, told those attending the Domestic Refrigerator Engineering Symposium. He explained that the Society of the Plastics Industry has been working with the ASHRAE 4.2 Technical Committee to determine the requirements of this industry and to work out satisfactory standards and test procedures which will result in plastics material meeting the needs more adequately.

W. E. Brown, Dow Chemical Co., presented some selected properties of plastics which were studied extensively in the interest of improving the performance and customer acceptance of plastics in domestic refrigerator appliances. Among the properties discussed were strength vs. temperature, long time strength and stability under load, heat distortion vs. load, chemical resistance and odor.

"Fabrication factors, or processing technology, are equal in importance to the realistic properties of plastics in producing refrigerator components which provide satisfactory performance", emphasized Dale Amos of the Amos-Thompson Corp. He pointed out that design engineers need a means of testing materials and components to determine if the material is satisfactory for the proposed design under consideration. Speaker Amos discussed the relation of functional factors to the various means of forming plastics components, injection molding, extrusion and vacuum forming in the important phases of current needs for systematic knowledge.

PRODUCT SUCCESS OR FAILURE

The broad area of "Engineering Responsibilities" was covered at the Air-Conditioning Symposium, unlike the topics of previous years when specific design details or criteria were discussed. According to W. R. Moll, Presiding Chairman, the engineer has another responsibility in addition to his basic concerns—he must be able to communicate ordinary engineering data into a working tool for other groups in the organization.

In taking care of his segment of responsibility, quite often the engineer "sees engineering for engineering's sake alone and not as it



Engineering responsibilities, largely commercial, were explored by Gerhardt Stoll, William Spiegelhalter, W. R. Moll, P. M. Augenstein and A. R. Rising at the Air-Conditioning Symposium. Chairman Moll here opens the session

should be—the backbone of an integrated, cooperative whole, bringing a needed and desirable benefit to humanity," pointed out Paul M. Augenstein of the Airtemp Div, Chrysler Corp. The engineer should design the product balanced to suit the customer, knowing all of the technical possibilities and at the same time the limitations and using this information positively.

Austin Rising, York Div, Borg-Warner Corp., stated that engineering function must be brought closely to the constantly changing demands of the market, and must be well integrated with the sales effort. Greatest sales will be realized by those companies whose engineering and marketing groups can produce products and features which the customer wants for the price he is willing to pay.

Engineering responsibilities go beyond the general impression that engineers take basic ideas and concepts and reduce them to either graphic or physical products, stressed W. G. Spiegelhalter, General Electric Co. The engineer must make himself heard and understood, especially when the specifications of his product are written. His responsibility to design primarily includes reliability, serviceability, quality and innovation. Further, he must keep abreast of developments both technical and non-technical which will influence the future course of his product.

Engineering responsibility includes new product planning in a durable consumer goods company where there are annual model changes, reminded Gerhardt Stoll, Whirlpool Corp. Thus, engineering should be consistently ahead in new product development; too often decisions on new products may be governed by competition rather than the needs of the customer or useful technology. As Mr. Stoll sees it, "The position of engineering as related to research and marketing can be described as a part of a spectrum with over-lapping boundaries but with clearly defined responsibilities that change during process of product development."

AS TO PSYCHROMETRY

Five speakers presented papers at the Psychrometric Chart Symposium, with P. N. Vinther as Presiding Chairman.

Roger Haines, Bridgers and Paxton, described the need for a high altitude psychrometric chart to the same scale and arrangement as the ASHRAE chart. The author described the methods used to calculate new tables for 3,850, 4,900 and 6,900 ft above sea level, which covers the localities of New Mexico and Colorado, where a need for such charts exists.

A new psychrometric chart providing solution of air conditioning problems for barometric pressures from 10 to 14.696 psia and for dry bulb temperatures from 0 to 120 F was introduced by Professor J. L. Threlkeld of the University of Minnesota. This chart, of the Mollier type, was constructed from psychrometric equations based on atmospheric air as a non-interacting mixture of dry air and water vapor.

The new chart also includes these properties: dry bulb temperature, thermodynamic wet bulb temperature, relative humidity and volume. Explaining the use of the new chart, the author also reviewed several earlier psychrometric charts.

A good psychrometric chart should be easy to understand, easy to use, correct thermodynamically and as complete as practicable, contended C. M. Ashley, Carrier Corp. He proposed a chart which uses a conventional coordinate system, but with enthalpy at 0% humidity together with enthalpy deviation lines to adjust the enthalpy to the state point. Since the enthalpy deviation is identical with the enthalpy of water added or removed at the entering or leaving wet bulb temperature, the calculation of the heat of a process is simplified.







Hotly pursued along several paths, essential facts were the goal of the Psychrometric Chart Symposium where P. N. Vinther was Chairman and speakers J. A. Goff (seated, left), J. L. Threlkeld, C. M. Ashley, D. D. Wile and R. W. Haines contributed their bits

Also, the dry bulb may be used as abscissa and enthalpy as ordinate, resulting in nearly horizontal wet bulb lines and sloping humidity ratio lines.

Additionally, ASRE Past-President Ashley suggested a chart for different barometric pressures which uses integral lines of enthalpy at 0% saturation and a series of saturation lines for the different altitudes together with a chart to indicate the enthalpy deviation and enthalpy of moisture added or removed.

The present Society psychrometric chart is rarely used by engineers in their day-to-day work because of its large size, multiple folding and complex pattern of lines, asserted D. D. Wile, Recold Corp. He recommended a chart including these characteristics – Should be printed on letter-size sheet, in a single color and on semi-transparent paper suitable for blueprinting. Two temperature ranges will be required to cover refrigeration and air conditioning applications. Use of wet bulb lines should be related to enthalpy at saturation. ASHRAE President Wile indicated that some expedient could be used to show the deviation between wet bulb line and true enthalpy.

The Society should insist upon thermodynamic consistency within the accuracy of existing knowledge as an essential feature of its psychrometric chart, contended Professor John A. Goff of the University of Pennsylvania, who set forth some of the requirements of thermodynamic consistency that the new psychrometric chart must meet to achieve relative permanence and accomplish sound educational objections.

OFF-THE-RECORD FORUMS

Six diversified topics, selected on the basis of popular interest expressed from various sources, were covered at the Forums, with E. N. Johnson as Chairman in Charge. The Forums and their Chairmen were: Frozen Food Storage, E. J. Robertson, Wilson & Co.; Air Conditioning Automobiles, K. A. Koch, Koch Engineering & Sales Co.; Supply Air Systems, J. H. Clarke, Visking Co.; Applications of Air-Cooled Condensers, D. E. Kramer, Kramer-Trenton Co.; Thermoelectric Effect, E. R. Wolfert, Whirlpool Corp.; and Piping and Pick-Up Factors, L. E. Seeley, H. B. Smith Co.



Speaker at the Welcome Luncheon was Dr. Willis M. Tate, President of Southern Methodist University



Past President Cecil Boling receives his Certificate of Appreciation for activities with ASHRAE

They Wanted to Know

Inquiries of the month to ASHRAE Headquarters covered many points as to technical facts, standards, practices, personnel and published references. From these, the following have been selected and condensed as being those replies of some general interest and value to ASHRAE members.

AIR CONDITIONING IN INDIA

To ASHRAE:

Am carrying out tests on a room air conditioner of my own design and would like to know the actual test conditions suitable in India to carry out exact performance tests. Would your standard test conditions be applicable in India, specifically Calcutta? Because, during the months of May, June and July, the ambient temperature is 90-100 F, and the relative humidity varies from 80-90 per cent.

T. C. G.

Test conditions for high temperatures are indicated in the ARI Standard 110-58. These are designated as the maximum operating conditions tests which specify for air-cooled units, room air temperature at 90 F db, 73 F wb, and outside air at 110 F db and 78 F wb. We would also suggest that you contact the Indian Society of Refrigerating Engineers in Calcutta.

FARM BULK MILK COOLING STANDARDS

To ASHRAE:

At a recent meeting of the 3-A task committee, the cooling section functional standard for farm bulk milk cooling was adopted. As written for this sanitary standard, the capacity requirements for refrigeration equipment are inferred and translation into normal Btu and engineering requirements for product load is obvious. In the form of "recommendations", ASAE is thinking of spelling this out in the more specific engineering terms and I am wondering if there is a similar interest in our ASHRAE. We are concerned, I'm sure, that competition is uniform between manufacturers and that satisfactory farm cooling in consonance with functional requirements is obtained. Would appreciate any comment you or others, who are concerned with agricultural product and farm refrigeration, would care to make.

C. P. D.

When the standard is available in printed form, we would like to send copies to members of our appropriate technical committees who are familiar with the subject. This is the best way to have industry comment, although there has been such a complete study made prior to the publication that we doubt if any adverse comments would be received. The real benefit of such a standard, of course, is only known after it has been published and placed in effect.

We would imagine that the members of ASHRAE who represent manufacturers of equipment for farm bulk milk cooling applications are also members of ASAE or 3A.

CAUSE OF HAMMER NOISE

To ASHRAE:

Do you know of any articles concerning the causes of and methods to eliminate hammer noises in steam piping systems?

C. H. L.

In general, this problem is caused by improper design of some part of the system. For good design principles concerning such systems, we would recommend that you refer to the ASHRAE GUIDE. In the 1959 edition, Chapter 26 is concerned with steam heating systems. In addition there are a number of references at the end of this chapter which would prove beneficial. Two such references on this subject are: Air Conditioning and Refrigeration by Jennings and Lewis and Heating and Air Conditioning by Allen, Walker, and James. One reference contains the following statement referring to the importance of drainage in steam systems: "Points at which an unusual quantity of water can collect in a piping system are undesirable in pipes through which steam flows at high velocity because of the possibility of water hammer. Water hammer is due to imperfect drainage inside of the steam pipes and other steam-heated surface."

WOULD LIKE TO COMMENT

To ASHRAE:

In the January ASHRAE JOURNAL there is an item stating that a revised plumbing code is being prepared and will be studied. Would it be possible for our office to obtain a copy of this preliminary code with a view to commenting on it from our aspect as consulting engineers and also with a view of checking with the City of Chattanooga officials. I realize that the comments which we might generate would apply only to a small portion of the entire country, but they might be helpful in your studies.

G. S. C.

The National Plumbing Code is being revised by an ASA Sectional Committee. You will note from the item in the JOURNAL that the US Public Health Service is preparing the draft revision. You may contact either the Public Health Service Technical Committee on Plumbing Standards or the ASA Sectional Committee A40, Minimum Requirements for Plumbing. Any comments you may have would be of interest to these groups working on the revision.

HEAT TRANSMISSION FACTORS

To ASHRAE:

We are interested in making tests to determine the heat transmission factors in some insulating materials used in air-conditioning and refrigeration. Could you furnish us with instructions or specifications to make this test?

P. B. G.

Tests to determine heat transmission factors in insulating materials are outlined in the publication, Standard Method of Test for Thermal Conductivity by Means of the Guarded Hot Plate. This is the American Society for Testing Materials Publication C-177-45. Copies are available from ASTM headquarters.

WHO'S WHO IN ASHRAE

Insofar as possible, these listings will each appear twice a year

ASHRAE OFFICERS, COMMITTEES
See April 1960 JOURNAL

REGION AND CHAPTER OFFICERS
See page 78, October JOURNAL

RESEARCH AND TECHNICAL COMMITTEES
See page 74, February JOURNAL

STANDARDS COMMITTEE
See page 89, November JOURNAL

INTER-SOCIETY COMMITTEES
See page 66, February JOURNAL

In high velocity systems

Duct parts create sound

as well as suppress it

Should it happen that a customer finds his air conditioning system to be "not as quiet" as the contractor and designer had predicted, the designer may demonstrate that the customer's claims are not well-founded by placing a speaker sound source at one end of the duct system. The sound may be barely audible at the other end, but when the system fans are turned on the noise problem still exists.

What then is the cause of the problem? Although the fan is the primary source of noise, some of this sound will be attenuated by the elbows, filters, and coils of the system. As the high-velocity air passes through these components (and for that matter over any projection into the air stream), each in turn serves as an individual noise generator, due primarily to air turbulence and vortex shedding. As a result, a condition in the duct system may be reached where the noise-generation level of the components begins to exceed the attenuated sound level from the fan. To date, most published data on the acoustic performance of elbows, commercial sound traps, and terminal devices are based on their sound-attenuation performance only, and probably were determined with speaker sound sources. With high-velocity systems becoming more prevalent, however, information on the noise-generation of the components must be known to predict accurately the expected levels within the duct, and ultimately within the occupied space.

The purpose of this study, therefore, was to determine as a function of frequency, both the noise generation and sound attenuation in elbows with turning vanes. Although the elbows and connecting duct were of standard Navy design, the information presented is applicable to commercial duct systems.



W. F. KERKA
Member ASHRAE

TEST APPARATUS

To measure noise generation, a system was needed to furnish sufficient quantities of air for producing desired velocities through the duct component being studied; while at the same time, the sound from the fan supplying the air quantities had to be attenuated below the level of the noise generated by the test device. Such a system is called a "quiet source of air." Fig. 1 illustrates the test system used in this study. Basically the noise generated by the fan was first attenuated in a large chamber lined with acoustic material, and secondly by two commercial sound traps mounted in parallel. The units were mounted in this way so that air velocities through them would be minimized, thus reducing the possibility of noise generation at this point in the system. Air flow was regulated by covering or opening flow nozzles (mounted on a partition in the chamber) and by adjusting a bleed-off port.

METHOD OF ANALYSIS

To best illustrate the method used in determining the noise-generation level, SPL_g, the data from one run have been included in an example as follows:

Elbow size = 18 x 18 in.

Elbow angle = 90 deg

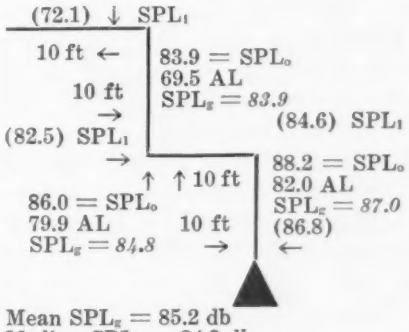
Octave band frequency, 600-1200 cps

No-flow attenuation of elbow, ΔSPL_a = 2.6 db

No-flow attenuation in 10 ft duct = 1.4 db

Velocity in duct = 4000 fpm

With three elbows in series, the schematic drawing of the setup is as follows:



Mean SPL_g = 85.2 db
Median SPL_g = 84.8 db

Although the tenths of a decibel were carried through all calculations, the accuracy of results is reported later.

Numbers in parenthesis represent the levels within the duct as determined from measurements taken along the centerline in the expanded section, and are the mean of four readings.

Input level to the first elbow, SPL_1 = 72.1 db. – Measured

Input level to the second elbow, SPL_1 = 82.5 db. – Measured

Input level to the third elbow, SPL_1 = 84.6 db. – Measured

Measured output level from the

W. F. Kerka is a Research Engineer, ASHRAE Research Laboratory. This paper, here slightly condensed, was presented as "Attenuation and Generation of Sound in Elbows With Turning Vanes", and is the result of research conducted at the Laboratory under a grant furnished by the Bureau of Ships, U. S. Navy, and was presented at the ASHRAE Semiannual Meeting in Dallas, Texas, February 1-4, 1960. The complete paper will appear in ASHRAE TRANSACTIONS.

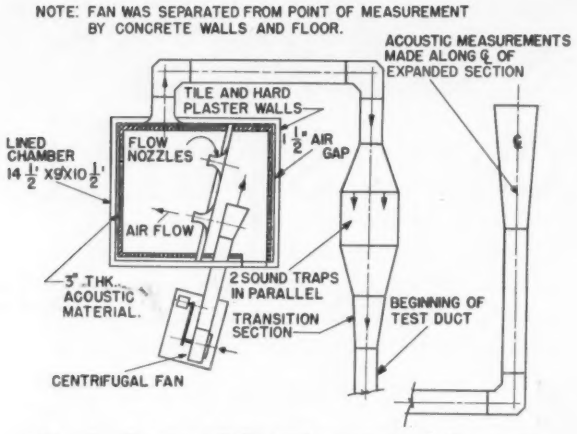


Fig. 1 Layout of the quiet source of air system

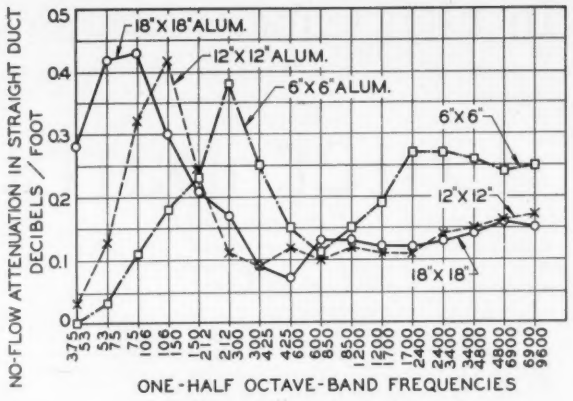


Fig. 2 No-flow attenuation vs. duct size ÷ wavelength

third elbow and 10 ft length of duct = 86.8 db. (This would have been the input level to a fourth elbow had another been added.)

To find the output level of each elbow, 1.4 db must be added (the no-flow attenuation in the duct) to the input levels as follows:

Output level from first elbow, SPL_o = 83.9 db (82.5 + 1.4)

Output level from second elbow, SPL_o = 86.0 db (84.6 + 1.4)

Output level from third elbow, SPL_o = 88.2 db (86.8 + 1.4)

However, due to the attenuation in each elbow the input levels are reduced by the amount of 2.6 db and are referred to as the attenuated levels (AL):

The attenuated level of the first elbow = 69.5 db (72.1 — 2.6)

The attenuated level of the second elbow = 79.9 db (82.5 — 2.6)

The attenuated level of the third elbow = 82.0 db (84.6 — 2.6)

By using Equation 2, the generated level of each elbow can now be determined. Taking the third elbow for example:

The output level, SPL_o = 88.2 db

The attenuated level =

$$= SPL_i - \Delta SPL_a$$
$$= 84.6 - 2.6$$
$$= 82.0 \text{ db}$$

Therefore, $SPL_o = 10 \log_{10}$

$$\left[10^{\frac{SPL_i - \Delta SPL_a}{10}} + 10^{\frac{SPL_g}{10}} \right] \quad (2)$$

$$8.82 = \log_{10} \left[10^{8.2} + 10^{\frac{SPL_g}{10}} \right]$$

taking the antilog of both sides of the equation,

$$\text{antilog}_{10}\, 8.82 = 10^{8.2} + 10^{\frac{SPL_g}{10}}$$

$$10^{8.82} - 10^{8.2} = 10^{\frac{SPL_g}{10}}$$

Therefore, SPL_g = 87 db

However, the generated level, SPL_g, can be found much more readily by using a background-noise correction chart as on p. 47 of Reference 4. This same procedure was followed in determining the noise-generation levels in the remaining octave bands and in all of the other elbows tested. The limiting condition in this method of analysis occurs when the attenuated level equals the output level SPL_o. In this case, the generated level,

$$SPL_g \cong SPL_o - 10 \text{ db}$$

RESULTS

Attenuation of sound in straight ducts—Attenuation per ft of length by half-octave bands for three duct sizes, 6 x 6 in., 12 x 12 in., and 18 x 18 in. is plotted in Fig. 2. The work of Chaddock has shown that the attenuation in unlined ducts is independent of the mass of the duct walls above 500 cps, but reaches a maximum at lower frequencies, depending upon the resonance frequency of the duct surfaces. This dependence upon mass appears evi-

Fig. 5 No-flow attenuation vs. elbow size ÷ wavelength

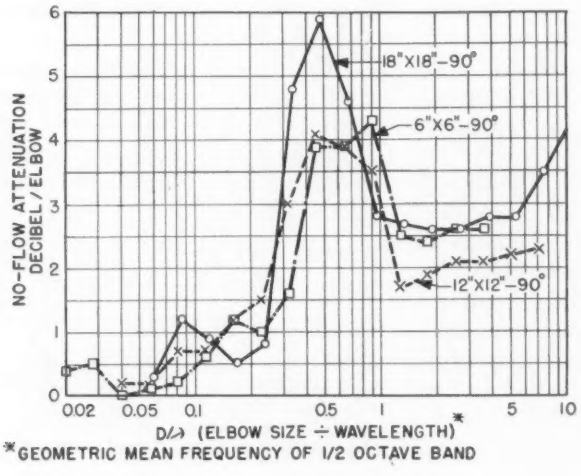
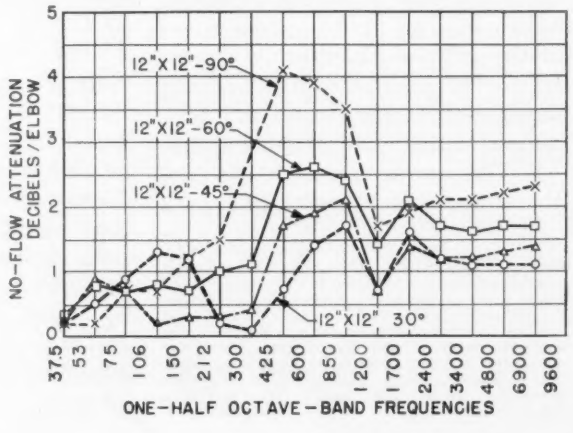


Fig. 6 No-flow attenuation vs. half-octave band frequencies for different elbow angles



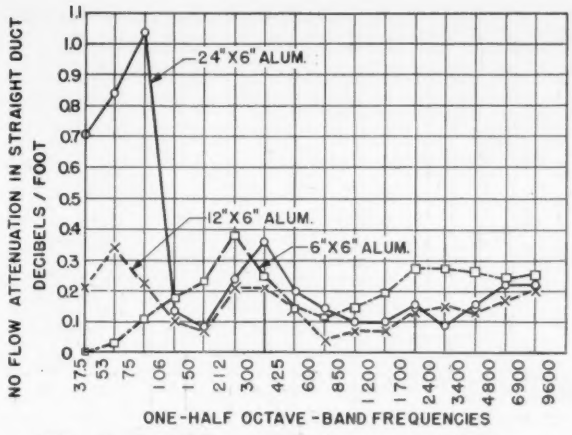


Fig. 3 No-flow attenuation vs. half-octave band frequencies for ducts of different aspect ratio

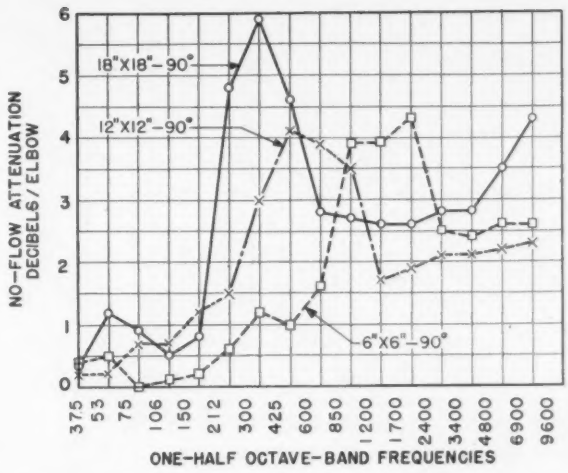


Fig. 4 No-flow attenuation vs. half-octave band frequencies for three 90-deg elbow sizes

dent as the peak attenuation shifts to a lower frequency with increased duct size. Although the wall thickness (standard wall thickness and description of ducts are listed in Table IA of the Appendix) increases with duct size, the added mass of the metal and especially the increased length of the undamped surface from edge to edge, causes the resonance frequency to decrease.

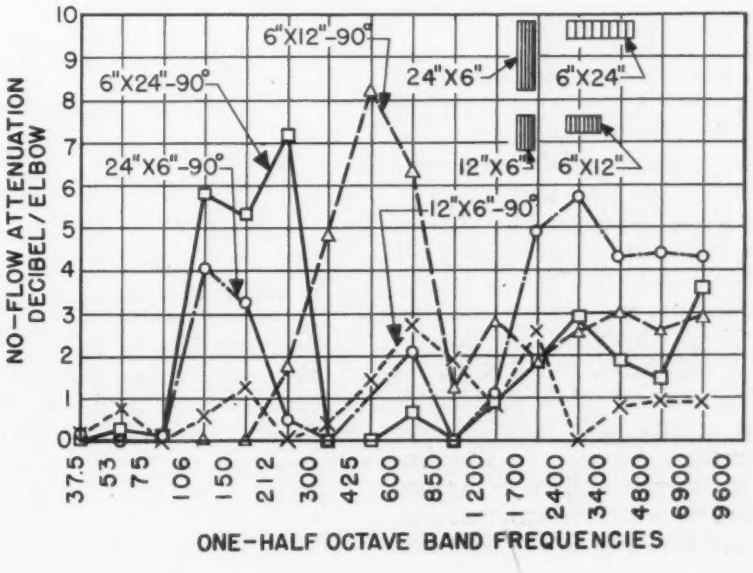
The independence of attenuation above 500 cps is evident in the 12 x 12 in. and 18 x 18 in. ducts where the relative magnitude of the decibel drop per ft is about the same as the results obtained by Chaddock for steel ducting. The attenuation in the 6 x 6 in. duct above 500 cps is somewhat higher than expected, however. Because of the small duct size, the microphone had to be positioned to 0-degree orientation.

Although the sensitivity to high frequencies is greater for this microphone position, this should not have been a factor in giving higher values since the attenuation results are based on the differences of absolute levels. It is possible, however, that the transverse modal effect that is quite pronounced at wavelengths equal to the duct dimension may have contributed to this.

Effect of aspect ratio on duct attenuation is illustrated in Fig. 3. Instead of only one peak attenuation value, as occurred in square ducts, two such points now appear as the aspect ratio is increased. The peak in the lower frequencies is evidently due to the resonance frequency of the two longer duct surfaces, while the other peak is caused by the resonant vibration of the shorter sides. In the 24 x 6 in. duct, stiffer angles had been riveted around the outer surfaces of each 10-ft section at the one-third points. This was in accordance with standard Navy practice. If the duct had not been stiffened, the lower attenuation peak would probably have shifted to the left. The heavier gauge metal in the duct walls has an added effect in stiffening the 6-in. side, hence the second peak occurs at a higher frequency than in the 6 x 6 in. duct. The independence of the attenuation from duct wall mass above 500 cps is again evident in the 24 x 6 in. and the 12 x 6 in. sizes. Under some conditions, Navy practice would call for a splitter septum in the 24 x 6 in. duct. In this case, the attenuation should be about the same as in the 12 x 6 in. duct. Attenuation of sound by octave bands is tabulated in Table IA of the Appendix for all of the ducts.

Attenuation of sound in 90-deg. elbows with turning vanes for three different sizes is shown in Fig. 4. (The physical dimensions of all the elbows will be included in the Appendix when the paper appears in ASHRAE Transactions.) In Fig. 5, the attenuation values have been plotted against the elbow size divided by the wavelength of the geometric mean frequency for each half-octave band. The peaks of attenuation at about ½ λ are evi-

Fig. 7 No-flow attenuation vs. half-octave band frequencies for 90-deg. elbows of different aspect ratio



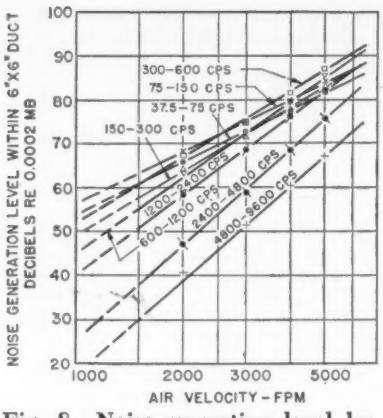


Fig. 8 Noise-generation level by octave bands vs. air velocity for 90-deg., 6 x 6 in. elbow

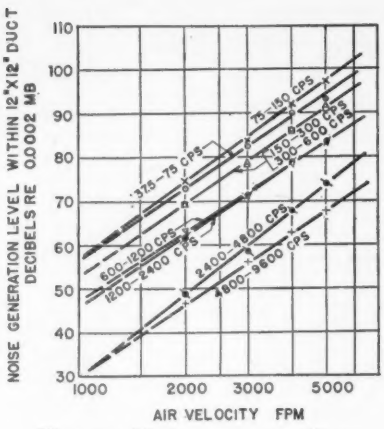


Fig. 9 Noise-generation level by octave bands vs. air velocity for 90-deg., 12 x 12 in. elbow

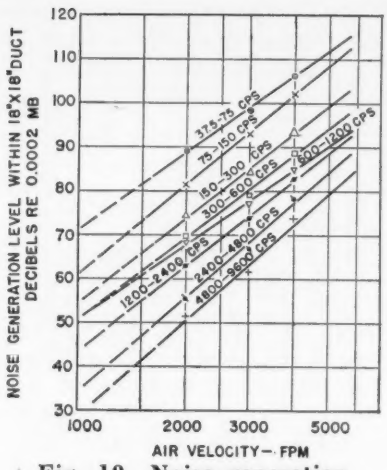


Fig. 10 Noise-generation level by octave bands vs. air velocity for 90-deg., 18 x 18 in. elbow

dent. This also appears to be true for elbows without turning vanes. The attenuation in the higher frequencies is also less than that expected from elbows without vanes.

In Fig. 6, the decrease in sound attenuation with a decrease in elbow angle is obvious. While the vane widths of the 45, 60, and 90 deg elbows are the same, there is less chance for the sound to be reflected as the vane decreases in curvature. The sudden rise in attenuation for the 30-deg. elbow in the lower frequencies is unexplainable. The difficulty of accurately measuring in the lower frequencies may have contributed to this apparent discrepancy. Although the results are for 12 x 12 in. elbows, it is expected that this same trend in the attenuation would exist for elbows of other sizes.

Trends in the sound attenuation over the half-octave band frequency range for the elbows of higher aspect ratio are not so evident, as shown in Fig. 7. In this case, two different types of elbows are involved for each ratio. In the 24 x 6 in. and 12 x 6 in. elbows, the turning vanes are of the same configuration, size and spacing as in the 6 x 6 in., 90-deg. elbows. Those in the 6 x 12 in. elbow are identical to the vanes in the 12 x 12 in., 90-deg. section, and the vanes in the 6 x 24 in. elbow are like those in the 18 x 18 in., 90-deg. section. As in the case of high-aspect-ratio ducts, several peaks appear in the attenuation curve over the frequency spectrum. Since only one each of these elbows was available, the results in Fig. 7 have been corrected to represent the mean attenuation of a number of elbows in series.

The sound attenuation by octave bands is tabulated in Table IIa of the Appendix for all of the elbows.

NOISE

Noise-generation levels, SPL_g, for each octave band versus the logarithm of the air velocity for three of the vaned elbows studied are shown in Figs. 8-10. In general, the spectrums appear to be broadband in nature (except for some pure-tone components which will be discussed later) and fall off in intensity in the higher frequencies. The slope of the lines drawn through the plotted points for the 6 x 6 in., 90-deg. elbow increases as the frequency increases. This would indicate that noise generation in the higher frequencies increases more rapidly as the velocity increases, and appears to be in accordance with the results obtained by Marvet in his study of grille noise. This trend is less evident in the 18 x 18 in. elbow. Except for the difference in the slope of the line representing the 2400-4800 cps band of the 12 x 12 in. elbow, the increase in generated level with velocity over the frequency range for this section appears to be fairly uniform.

In the rest of the vaned elbow studies (see Table IIA of the Appendix), the more rapid increase in noise generation in the higher frequencies with increased air velocity was evident in the 12 x 6 in. and 6 x 12 in. elbows. In the 6 x 6 in. elbow, Fig. 8, the less rapid rise in level in the lower frequencies may be due to the relatively small volume enclosed by the duct walls, and hence the inability of the acoustic environment to excite suf-

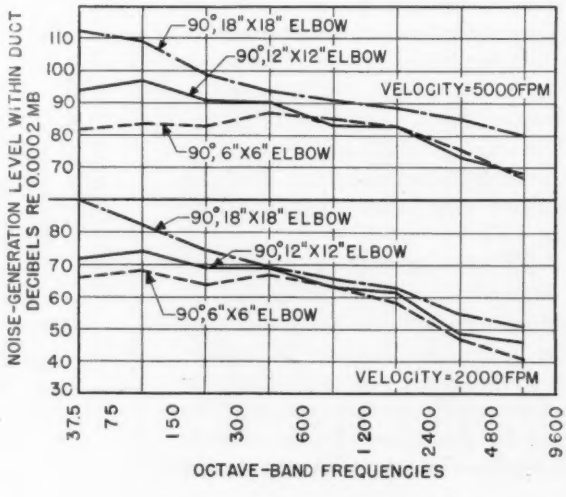


Fig. 11 Noise-generation level by octave bands for three elbow sizes

ficient low-frequency modes.

Effect on noise-generation level with respect to elbow size, angle, and aspect ratio is shown in Figs. 11, 12, and 13. In Fig. 11 the marked increase in generated level in the lower frequencies with an increase in elbow size is evident. One would expect that the differences in levels would become less as the frequency increased, and that the smallest section would generate the highest level in the upper octave bands, as has been found for diffuser noise.

Note again, in Fig. 11, deviations from this expected trend need further investigation to establish a definite relationship between generated level and elbow size. The comparison of these levels is relative, however, as the elbows are not geometrically similar in regard to the dimensions of the turning vanes. If a comparison were made on a power-level basis, a correction for the duct cross sectional area would have to be included as noted by Equation 3.

Therefore, in Fig. 11, 6 db would be subtracted from the levels of the 6 x 6 in. elbow and 3.5 db added to levels of 18 x 18 in. elbow to convert to a power-level basis.

General increase in level with elbow size was first thought to be due, in part, to the increased turbulence caused by thicker turning vanes, together with the change in frequency of the vortex-shedding process. However, this appears not to be the case since the vane thickness of the 12 x 12 in. and 18 x 18 in. elbows are the same, whereas the generated levels of the latter are generally greater for a given flow rate. The other factors that could affect the level are the vane width and configuration and the dimensions and volume of the acoustic environment bounded by the surfaces of the elbow and the connecting duct (now referred to as the acoustic coupling of the elbow to its duct).

The effect of the vane width and configuration does not appear to be a factor, however, when Fig. 12 is examined. In this case, the generated levels in each octave band were plotted against the elbow angle since all sections were of the same (12 x 12 in.) size. The generated levels remain fairly constant over the low and mid-frequency range, although the vane thickness and width of the 30-deg. elbow was less than those of the 45, 60, and 90-deg. sections. The vane configuration (shape) and spacing of each section also differed.

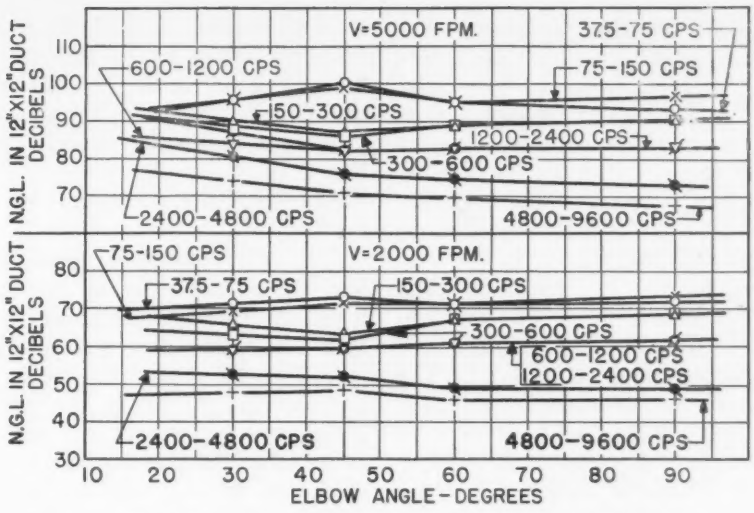


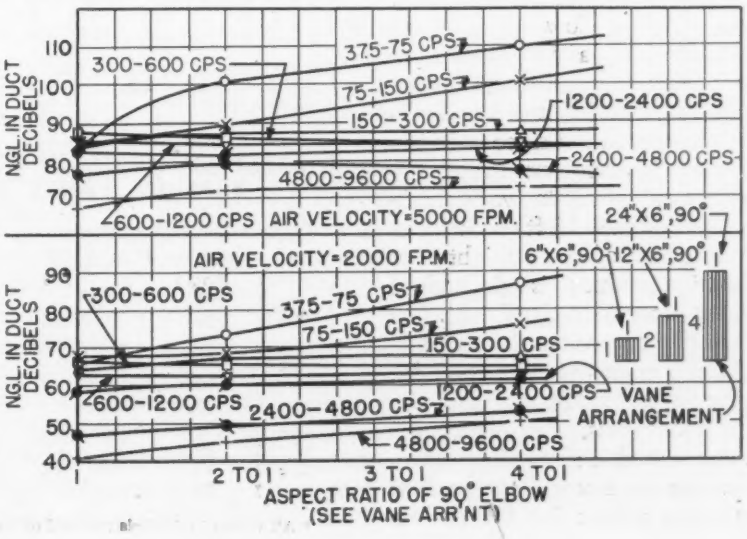
Fig. 12 Noise-generation level vs. elbow angle

The general increase in level in the higher frequencies for the 30 and 45-deg. elbows may have been due in part to harmonic frequencies generated by the vibrating vanes in these sections. The closer vane spacing of the 30-deg. elbow may have also been a cause of greater high-frequency noise, although this appears not to be so in the case of the 45-deg. section. In this elbow, the vanes had the greatest spacing, yet the increase in level in the higher octave bands is also evident from Fig. 12.

The fact that the noise-generation level remained constant over the low and mid-frequency range for a given elbow size, even though the angle and other parameters changed, would indicate that the dimensions of the elbow and its acoustic coupling with the adjacent duct are influencing factors.

Effect of aspect ratio on noise generation is illustrated in Fig. 13, with the vane arrangement as noted. In each section the vane configuration, size, and spacing were identical to those of the 90-deg., 6 x 6 in. elbow; only the vane length differed. Essentially the same experimental results were obtained for the elbows that were of the same aspect ratio, but opposite in the plane of turning. In this case the vanes (all were 6 in. long in each of these three sections) in the 2 to 1, aspect-ratio elbow were identical to those in 90-deg. 12 x 12 in. elbow, and those in the 4 to 1 sec-

Fig. 13 Noise-generation level vs. aspect ratio, 1 to 1, 2 to 1, 4 to 1



tion were identical to those in the 90-deg., 18 x 18 in. section. Therefore, the increase in the generated level in the lower frequencies as the aspect ratio increases appears to be influenced more by the dimensions of the elbow and connecting duct than by the turning vanes themselves. Again the larger volume bounded by the duct walls for the 24 x 6 in. (4 to 1) section would promote the excitation of more low-frequency modes. The relatively constant level in the mid-frequency range with change in aspect ratio is evident. The slight rise in generated level in the higher frequency bands with increased aspect ratio was noted for both types of elbows, and hence could not be attributed to a specific vane characteristic.

Because only one each of each type of 2 to 1 and 4 to 1 aspect-ratio elbows were available for testing, the accuracy of the no-flow attenuation values and hence the determined generated levels are considered with somewhat less accuracy than the results for the average of three sections. The conclusions drawn from Fig. 13 should therefore consider this fact.

EFFECT ON NOISE

During these noise-generation studies, one each of the 30 and 45 deg. elbows was observed to produce pure-tone sounds at specific air velocities. It was found, however, that only a few of the vanes were responsible for this due to excessive vibration. The problem could easily be rectified by tack-welding a rod across the leading edge of the vanes at the midpoint.

In the no-flow attenuation studies, the accuracy of results depended mainly upon the stability of the instrumentation and the technique of observation since only the differences in levels were used. Although measurements were made at the end of each 10-ft section, the final accuracy of the straight-duct attenuation values is dependent upon the error in 30 ft of duct. For the first two octave bands the maximum order of error is about ± 1 db, and for the last six bands, ± 0.5 db. On a foot basis, the errors are ± 0.05 db and ± 0.02 db respectively. The accuracy of the no-flow attenuation values for the elbows is of the order of ± 1.5 db in the first two octave bands and ± 1 db in the last six bands. This includes the expected error in the attenuation of the connecting straight duct. Where only one elbow was available for testing, the accuracy would be less.

In the noise-generation studies where the order of accuracy was basically dependent upon absolute levels, the accuracy was observed to be about ± 4 db in the first octave, ± 3 db in the second band, and ± 2 db in the last six octave bands. The errors also include any factor contributed by the performance of the expanded section (at the end of the duct system) in not acting as an ideal horn termination in the lower frequency bands.

CONCLUSIONS

The no-flow attenuation in the lower frequencies of unlined ducting is dependent upon the mass and resonance frequency of the duct walls.

For higher aspect-ratio ducts, two peaks of attenuation occur in the lower frequencies due to the different resonance frequencies of the longer and shorter sides.

Above 500 cps the no-flow attenuation in the mid frequencies (except for the smallest duct studied) is about 0.1 db per ft and rises to a somewhat higher value in the higher frequencies. This is in accordance with the results of other investigators.

The no-flow attenuation in elbows with turning vanes is dependent upon the elbow size and angle.

The noise-generation levels of vaned elbows are significant, and in general may be only about 10 db less than the level of the fan in the system.

For vaned elbows of the same size but of different angle, the noise-generation level in the low and mid-frequency range is about the same for a given air velocity.

The noise-generation level in the low frequencies of vaned elbows of the same angle increases markedly as the size increases.

The noise-generation level of vaned elbows of different aspect ratios (with opposite sides remaining constant in size) is nearly the same in the mid frequencies but increases in the lower frequencies and to a lesser extent in high frequencies as the aspect ratio increases.

APPENDIX

TABLE IA NO-FLOW ATTENUATION* IN STRAIGHT UNLINED AND UNINSULATED ALUMINUM DUCT BY OCTAVE-BAND ANALYSIS

Duct Dimensions Inches	37.5 75	75 150	150 300	300 600	600 1200	1200 2400	2400 4800	4800 9600	Wall Thickness Inches
6 x 6	0.03	0.11	0.29	0.21	0.13	0.25	0.26	0.25	0.032
12 x 12	0.08	0.36	0.13	0.11	0.11	0.12	0.16	0.16	0.051
18 x 18	0.39	0.37	0.18	0.07	0.14	0.10	0.14	0.17	0.064
6 x 12[a]	0.29	0.18	0.14	0.18	0.06	0.08	0.12	0.18	0.051
6 x 24[b]	0.83	0.70	0.14	0.26	0.08	0.12	0.12	0.16	0.064

* All values in decibels per foot
a. Also applies to 12 in x 6 in duct
b. Also applies to 24 in x 6 in duct

TABLE IIA NO-FLOW ATTENUATION* IN ELBOWS WITH TURNING VANES BY OCTAVE-BAND ANALYSIS

Elbow Size Inches	Elbow Angle	Octave-Band Frequencies 37.5 75	75 150	150 300	300 600	600 1200	1200 2400	2400 4800	4800 9600
6 x 6	90	0	0	0.5	1	2	4	2	2.5
12 x 12	90	0	0.5	1.5	3.5	3.5	2	2	2.5
18 x 18	90	1	0.5	2	5	2.5	2.5	3	3
6 x 12	90	0.5	0	0	6	1.5	1	3.5	3.5
6 x 24	90	0	2.5	7	0	0	0.5	3	3
12 x 6	90	0	0	0.5	1	2	3.5	1	1
24 x 6	90	0	0	2	1	1.5	4	5.5	5
12 x 12	60	0.5	1	1	1.5	2.5	2	1.5	1.5
12 x 12	45	0	0.5	0	1	2	1	1	1.5
12 x 12	30	0	1	0.5	0.5	1.5	1	1	1

* All values in decibels rounded off to nearest ½ decibel.

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Program planning in the consolidated Society takes on only a slightly different aspect from that existing in one or both of the predecessor societies. There are still and will always be a continuing number of miscellaneous subjects on which technical papers must be presented. Many of these subjects, even though not directly related, are in related fields, in which case a technical session covering a general field of interest can be presented. Others simply stand alone, in which case a technical session consisting entirely of unrelated subjects is presented for those few members needing this information.

Then there is always the need for exchange of technical information and discussion on current subjects, perhaps on a specific problem facing an industry. In this case a conference or symposium is held, at which papers are generally presented but at which discussion from the floor is all important.

Last, but not least, are the forums which cover an individual subject, usually of current or future interest, on which no prepared papers are presented. These sessions are unrecorded and feature "Let your hair down" type of discussions, from which everyone benefits and as a consequence results in real advancement of the art.

The mechanics of conducting the program likewise assumes real importance. Time scheduling of each and every paper at a technical session allows the member to select those papers in which he is most interested and be assured of hearing the presentation at the scheduled time. This practice is not generally followed in connection with a conference, since all papers are related and it is assumed the member will attend the entire session.

Limitation of time for presenting each paper assures adequate time for discussion from the floor, which again allows more members to participate in the activities of the Society.

Finally, every member should know that the presentation of the program at a National meeting is only another week in the life of the Program Committee. Forward planning is imperative and the Committee is at all times looking ahead to one or two programs in the future. Successful completion of these future programs depends on the ability of the Committee members to procure papers on selected subject as scheduled, and on the building of a backlog of good technical papers, generally referred to as the "Technical Paper Prospect List."

Every member having sound technical information which will advance the art should contact Program Committee members.

As the Society expands its operations, the program will become more complex. The Program Committee will serve as the clearinghouse for technical information and the membership can look forward to a smooth and enlightening program which will benefit everyone.

5 years of operational experience prove

Air-to-air heat pump

to be effective in northern climate



JAMES S. ENGLUND

In post-war years the heat pump has become accepted by the public in some parts of the country as a residential year-round air conditioner. Because it has a favorable coefficient of performance, such a unit can do an admirable job of electrically heating in winter and cooling in summer at a reasonable cost. Thousands of residential heat pumps in the southern and middle belts of our country are working in generally mild outdoor temperatures to produce comfort conditions indoors.

The northern belt presents a different problem. Summers are generally mild and call for relatively little comfort cooling. Low outdoor temperatures occur practically every winter. These weather conditions may create large demands on residential heating systems and their energy sources. Energy needs for summer cooling are negligible by comparison.

There is beginning to be some demand for residential heat pumps in the Pacific Northwest. The Engineering Experiment Station in the Div of Industrial Research of Washington State University, with the cooperation of the Washington Water Power Company, has been studying this load. The method chosen was to obtain power demands and consumption as well as operating and performance data of an air-to-air heat pump heating an actual residence. To this end, a heat pump was built during the summer of 1954 and installed in a residence in Pullman, Wash.

THE RESIDENCE

The residence is a six-room frame house of 1177 sq ft area. The walls and ceiling are insulated and storm windows and storm doors are used during the heating season. The basement of 624 sq ft area, located under the central part of the house, is used for laundry, hot water heating and heat pump equipment as well as for general storage. The basement temperature is maintained above 60 F. The calculated heat load of the house was 38,560 Btu per hr at 70 F temperature difference. However, for performance purposes, the heat loss was determined in another way.

From the beginning of the study it was seen that a calibration of the building was necessary to determine its actual heat requirements. Therefore, during several periods of the first heating season the heat pump was shut off and all heat was supplied by electric resistance heaters.

The four calibration periods totaled 28 days during which 2912 kw-hr were used for heating. The accumulated degree days for these periods was 756.1 or an average of 27.0. A convenient constant was derived from these results – 3.85 $\frac{\text{kw-hr}}{\text{day}}$ per degree day. This figure is the basis of the heat requirement curve for the residence. One major change in the house was the installation of an electric clothes dryer in the fall of 1958. This affected the domestic electric usage pattern.

DESIGN OF HEAT PUMP UNIT

An analysis of weather data showed that January, the coldest month, has an average temperature of 27 F in the Pullman area in a normal winter. The minimum temperature is –30 F, but –10 F is often used as a design temperature. A large heat pump could have been built to carry the heat load at –10 F or –30 F, but it would be quite expensive and its full capacity would be used only a few hours a year. It seemed more practical to size the heat pump to supply the necessary heat during normal weather, and to supplement its output with heat from another source during periods of abnormally low temperatures. This appeared to be a reasonable method for determining the capacity of a heat pump to be installed in a given structure.

No heat load due to wind was computed because experience shows that during periods of low temperatures there is little or no wind. Wind loads do occur during milder weather, but do not add to the maximum heat load.

From the above conditions it was seen that about 23,600 Btu per hr of heat would be required when the outdoor temperature is 27 F. A 3-hp machine appeared to be capable and the design was based on this size.

During the summer of 1954 a heat pump was built and installed in a residence in Pullman, Wash., to determine the electric load this machine creates in a northern climate. After five years of operational experience and study of weather, heat pump performance, energy requirements, and operating difficulties, the author draws some highly pertinent conclusions as to performance and occupant reaction.

James S. Englund is an Associate Mechanical Engineer, Div. of Industrial Research, Washington State University.

Many commercially-built heat pumps rely on electric resistance units for supplemental heat at abnormally low outdoor temperatures. This plan was adopted to give experimental results typical of expected installations. Three resistance units of 2.4 kw capacity (7.2 kw total) were connected. The supplemental heaters were controlled by a two-step thermostat. Provision was made to connect two resistance units on the first step in extremely cold weather.

This heat pump was to be built from available components to save cost. Parts from several manufacturers were used to build an indoor and an outdoor section. The indoor section contains the motor-compressor, condenser, indoor air fan, supplemental heaters, controls, and defrosting system. The evaporator and fan comprise the outdoor section. The use of available parts limited, to some extent, the designers' freedom on some details.

Being standard refrigeration equipment, the evaporator and condenser coils mounted large vapor and small liquid connections. Some thought was given to enlarging the small connections to permit full vapor flow resulting from reversed operation for summer cooling. This was not done because the project was concerned with heating. Also, cooling is needed relatively few days a year in this area.

Another feature that was controlled by the nature of the components was the defrosting system. The evaporators (actually two coils) were equipped with spreader type trays for water defrost. Although the use of water flooding over the coils was considered to be second-best to a hot gas method, it was adopted on a trial basis.

During heat pump operation, a tank of water is warmed by subcooling the refrigerant on its way to the expansion valves. At defrost time the water is pumped to flood the evaporator coils melting the frost. Drainage is returned to the tank and the overflow is wasted. Defrosting is controlled by an automatic cycle switch timed to cycle twice daily. This system requires no city water and does not create a water disposal problem.

Four kw-hr integrating meters indicate power consumption for the compressor motor, the auxiliary motors, the supplemental heaters and the total. A recording demand meter shows the system demand at all times. Compressor operating time is indicated by a running time meter, and outdoor air temperatures are logged by a recording thermometer. Weekly readings are made of all indicating meters as well as of the residence kw-hr meter.

RESULTS

Weather – Compared with normal weather, the first three winters involved in this five year study were fairly typical and the last two have been unusually mild. Table I gives normal degree days (from the ASHRAE GUIDE) for several cities in the Pullman area as well as an estimate of the degree days for Pullman. The estimate was made from Weather Bureau data recorded by the United States Department of Agriculture in Pullman and indicates that the winters of the last six years have been somewhat milder than the 50 year average.

Table II summarizes the weather during the five years that the heat pump operated. Due to the heating aspect of the experiment, figures are shown for fiscal years beginning with July 1.

Heat load – The heat requirement of the house was determined by calibration, as described above, and has been plotted in Fig. 1 along with the capacity of the heat pump. This calibration takes account of about 4200 Btu per hr average of domestic usage, most of which is additional heat input. That is, this usage supplies some heat whether the heat pump is needed or not. The calibration neglects some outside factors which affect heat loss, such as wind variations and solar radiation. It is felt that the calibration periods were representative of all weather conditions; and, therefore, that the heat loss curve is valid. This is substantiated by the calculated heat loss value of 38,560 Btu per hr at 70 F inside temperature and 0 F outside.

It is to be noted that the "balance" point of 25 F is just below the normal January average temperature. This has resulted, as planned, in a pattern which requires the use of supplemental heaters only during periods of abnormally low outdoor air temperatures.

Heat pump performance – Fig. 1 carries a curve showing heat output of this machine plotted against outdoor temperature. This performance curve was calculated from compressor capacity data. A good check of actual performance is possible only at the "balance" temperature, 25 F outdoors. Under this condition the heat pump runs continuously and is just able to maintain the desired indoor temperature without the need for supplemental heat. This performance check has been made a number of times. For occasional periods of one to three days practically every year, the outdoor temperature remains steady, not changing more than a degree or two from day to night. This condition usually occurs under a thick cloud cover with no wind. When the steady temperature happens to be 25 F, there is a condition of steady state

TABLE I

ANNUAL NORMAL DEGREE DAYS

Cities	Degree Days
Spokane, Wash.	6852
Walla Walla, Wash.	4848
Lewiston, Idaho	5483
Pullman, Wash. ('53-'58 only)	6628
Pullman, Wash. (50 yr. average)	6938

TABLE II

WEATHER DATA FOR 1954 TO 1959

FISCAL YEARS FROM JULY 1 TO JUNE 30

Year	1954-55	1955-56	1956-57	1957-58	1958-59
Degree Days					
Weather Bureau	7194	7137	7026	5863	6292
Recorder on Site	7381	6882	6626	5890	6183
Minimum Temp. F	0	—12	—24	+17	—1
Heating Season Start	Sept. 9	Sept. 21	Oct. 7	Sept. 1	Sept. 14
Heating Season End	June 5	June 10	June 9	May 18	June 28

heat flow (no change of heat storage) through the walls of the house. At these times it has been observed that the heat loss is equal to the output of the heat pump.

For purposes of comparison the heat output performance of this heat pump is given in Table III.

Energy requirements – The energy consumption of this heat pump is shown in Table IV. Demands, load factors, and domestic consumption are included. It will be noted that this heat pump is a large user of electric power – substantially the same as all other domestic uses combined.

One of the principal drawbacks to the general use of heat pump units in northern regions is the relatively high demand and low load factor of the supplemental heaters. These heaters, while convenient for the customer, impose a relatively large load on the power supplier, who during abnormally cold weather already faces the maximum load of the year on his system. He may be concerned about any addition to the system peak by supplemental heaters. Such additions will occur to the extent that the supplemental heat demand coincides with the system peak.

Fig. 2 shows outdoor temperature and heating system (heat pump plus supplemental) demand plotted against time for the three coldest days of the five year operating period. Note that the third step of supplemental heat operated intermittently during the system peak hours of 4 to 6 p.m. each day. Even though it is small, this is a relief at a critical time.

In Table IV it is seen that this heating plant materially increases the power demand of the residence. Comparison of the several years shows that the supplemental heaters are responsible for the major part of the increase in demand. Note should be taken of the increase of domestic demand (apart from heat) for the 1958-59 season. This is due to the clothes dryer added in the fall of the year.

Comparison of the load factors of the heat pump with that of the other residential uses shows that this heating plant, including the supplemental heaters, is of the same order as the domestic uses without the heat pump. Furthermore, during the two mild winters the overall load factor of the residence including heating was higher than that for domestic uses only. Therefore the power supplier, who sees this residence as a single load, can assign a higher load factor (as well as much greater energy consumption) to this residence because it has a heat pump than if another form of heat were used.

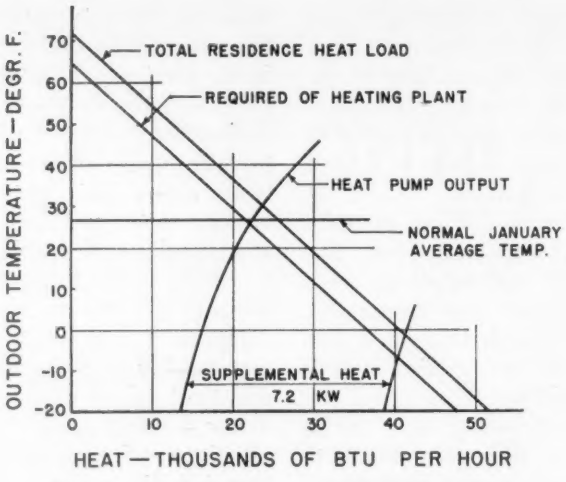


Fig. 1 Air-to-air heat pump performance

OPERATING DIFFICULTIES

Fatigue cracks in pipes – A few weeks after the machine was placed in operation, a crack in the compressor suction line appeared near the compressor. It resulted from insufficient flexibility in the pipe to handle compressor vibration. The pipe was rerouted and fitted with a flexible metal hose. No further difficulty has developed.

Motors – During the first season of operation the centrifugal switch which controls the starting winding of the compressor motor became inoperative. The switch was dismantled, cleaned, oiled and reassembled. At the beginning of the third season the evaporator fan motor starting capacitor failed and was replaced.

Defrosting – Generally speaking, the water defrost system has performed well. The defrosting system is needed only during the winter, usually from about the middle of November until the middle of March. As a rule two defrost cycles daily have been sufficient. Three problems that are related to the defrost system have occurred. The first problem is the collection of snow on the protective screens. See Fig. 3 for view of evaporator. This happened only occasionally, not more than once or twice a winter. When large, wet snow flakes were carried by the air entering the evaporator, the snow quickly formed a thick blanket over the screen and stopped the air flow to the evaporator.

During one season a heating

TABLE III
HEAT PUMP PERFORMANCE

	Heat Pump only Btu per hr	Including Supplementation Btu per hr.
Capacity at 45 F O.D. Temp.	29,000	53,200
30 F O.D. Temp.	24,100	48,300
10 F O.D. Temp.	17,700	41,900
—10 F O.D. Temp.	13,300	37,500

Coefficient of Performance — By Seasons
Based on all power for heating including fans & supplemental

Heating Season	C.O.P.
1954-55	2.10
1955-56	2.12
1956-57	2.17
1957-58	2.75
1958-59	2.67

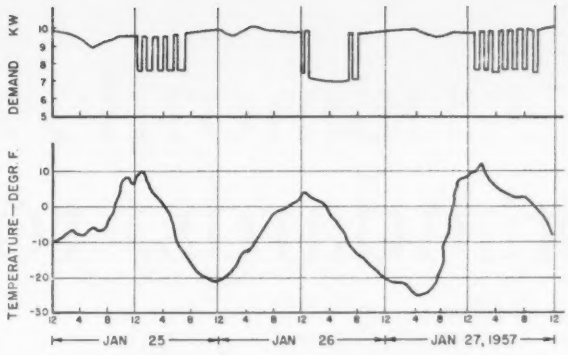


Fig. 2 Heating plant kw demand and hourly temperature for three cold days

cable was secured to one screen and energized for ten minutes during each defrost cycle. This cable used 400 watt and seemed to be effective in removing a snow "blanket" from the screen. That season the snow blanket was rather light and occurred only once. Therefore, this was not a thorough test. Now hoods have been built over the evaporator air inlets which prevent rain and wet snow from reaching the screen surfaces, thereby eliminating the removal problem.

The second problem is similar to the first except that it was caused by snow and rain which were drawn into the evaporator with the air. This moisture, due to its downward direction of fall, collected faster in the lower part of the evaporator than in the upper. The evaporator is composed of five parallel refrigerant circuits, one above the other, and the thermo bulb on the expansion valve senses the average outlet temperature of the five refrigerant circuits. When the bottom circuit is unloaded due to a stoppage of air flow by snow or ice, the expansion valve reduces the refrigerant flow to all circuits. This causes the evaporator temperature to drop with a consequent increase in the rate of frost collection over the entire evaporator coil. The evaporator hoods mentioned above have greatly reduced, if not eliminated, the problem of unequal loading of evaporator coil circuits.

The third problem related to the defrost system was a peculiarity of this custom built heat pump, but it indicates a potential source of trouble in all air source units. It resulted from dust and other airborne material which, in this machine, was washed off of the tubes and returned to the tank with the defrost water. On a subsequent defrost cycle this material was pumped with the water and collected on the water spreading trays above the evaporator tubes. In time the tray slots became clogged, causing the defrost action to be only partially effective. Removal of the trays for cleaning two or three times during each defrosting season was necessary and once the foreign material partially clogged the defrost water pump. This cannot occur again due to the installation of a strainer in the defrost drain line and smaller mesh screens across the evaporator air inlets.

This third problem indicates that dust and other airborne material is a potential trouble maker in the defrost drainage system of an outdoor evaporator. Here it was accentuated by the reuse of the drained water.

Where the house design permits, all of these problems may be eliminated by a method suggested by R. C. Schlichtig, inventor and former heat pump builder in Spokane, Wash. This method is to draw outdoor air into the attic space through vents located under the eaves of the roof. From the attic, the air, probably free of all large sized foreign matter, is ducted to the evaporator, and then discharged outdoors. The price of this advantageous arrangement is, of course, one of interior space occupied by ductwork and the outdoor air handling portion of the heat pump.

TABLE IV

ENERGY REQUIREMENTS — ANNUAL FOR FISCAL YEARS, JULY 1 TO JUNE 30

SEASON		1954-55	1955-56	1956-57	1957-58	1958-59
POWER						
Heat Pump	kw-hr	12,220[1]	10,425	9,665	8,236	7,622
Supplemental	kw-hr	904[1]	2,083	2,084	4	676
All Heating	kw-hr	13,124[1]	12,508	11,749	8,240	8,298
Domestic	kw-hr	10,358[1]	11,104	9,833	9,399	11,163
Total Residence	kw-hr	23,482[1]	23,612	21,582	17,639	19,461
DEMAND (15 min)						
Heat Pump	kw	3.8	3.5	3.6	3.5	3.5
All Heating	kw	10.6	10.6	10.1	5.4	7.7
Total Residence	kw	14.1	14.0	15.0	9.0	14.0
Domestic, no heat[2]	kw	—	5.3	5.3	6.0	10.2
LOAD FACTORS						
Heat Pump	%	36.7	34.0	30.6	26.8	24.8
Supplemental	%	1.5	3.3	3.7	0	1.8
All Heating	%	14.1	13.5	13.3	17.4	12.3
Total Residence	%	19.0	19.2	16.4	22.4	15.8
Domestic, no heat	%	—	23.9	21.2	17.9	13.0

[1]Corrected value after thermal calibration
[2]Summer Value

CONCLUSIONS

1. The residential heat pump, apart from supplemental heaters, is a relatively large user of electric power at a reasonable load factor.
2. Electric supplemental heat, having a high demand and low load factor in itself, appears more desirable when viewed in its true setting as part of a residence load. Here electric supplemental heat is seen to complement residential usage to give an overall load factor of the same order as the residence without a heat pump.
3. During extremely cold weather supplemental heaters have the favorable characteristic of a reduced demand during the hours of 4 to 6 p.m. when the electric system peak load may occur.
4. The heat pump supplemented

(*Continued on page* 70)

Modular standards, too

A. T. BOGGS, III
ASHRAE Technical Secretary

TEMA – A new edition of the Standards of the **Tubular Exchanger Manufacturers Association** has been published recently. The new TEMA standards provide detailed information on the design and engineering of tubular heat exchangers. In addition to outlining mechanical standards for heat exchangers, this revised publication includes thermal data, material specifications, and general design information. Copies of the 144-page book may be obtained from Tubular Exchanger Manufacturers Association, 53 Park Place, New York 7, N. Y., at $6 per copy ($7 to foreign addresses).

BRI – The **Modular Building Standards Association** reported to the BRI Fall Conference in November 1959 that its surveys indicate that two out of three architects incorporate modular materials in their projects whenever possible. These are materials produced in multiples of 4 in. including joints, conforming to American Standard A62.1-1957. It has been reported that the American Standard 4-in. module is also widely used throughout Canada, Europe, and Australia with the metric countries using a 10 centimeter module.

ASA – American Standard C57.12.20-1959 titled **Overhead-Type Distribution Transformers,** 67,000 volt and below, 500 kva and smaller, has been revised and is now available from American Standards Association. The new publication is Section 20 of the basic American Standard C57.12. Copies are available from ASA at $2.30 each.

ASA – American Standard ASA B16.23-1960, **Cast-Bronze Solder-Joint Drainage Fittings.** This revision to the American Standard was approved by ASA on January 15, 1960. Copies are available from ASA or ASME at a cost of $2 each. This standard covers cast-bronze solder-joint drainage fittings designed for use with copper water tube. These fittings are designed for drainage and vent systems using the solder-joint method of connection. This standard does not apply to cast-bronze solder-joint pressure fittings. Such fittings are covered by ASA B16.18.

ISO – The latest effort at international standardization was concerned with office machines and data-processing equipment. Initiation of two standards projects was recommended by representatives of 27 organizations meeting at an ASA Conference on January 13. The project on office machines will be handled by the newly-formed ISO technical committee 95 and is under the administrative direction of the Italian Standards Organization. The scope of the office machines committee will be standardization of terminology and definitions of functions of office machines and other fundamental elements such as output formats. Standardization on data processing equipment would provide a basis for passing information from one data-processing system to another, for performing the same process on differing machines, and reducing the effort expended in preparing programs describing data processing.

Temperature Symposium – A symposium devoted to the subject of temperature measurement is being developed jointly by the American Institute of Physics, the Instrument Society of America and the National Bureau of Standards. The symposium will be presented sometime in the spring of 1961. The area covered will include temperature, its measurement and control in science and industry. A similar symposium on this subject was conducted in 1939. ASHRAE will be represented on the Program Committee. It is expected that the Society will have representation on the program.

3600-TON COOLING SYSTEM FOR HOUSTON BANK

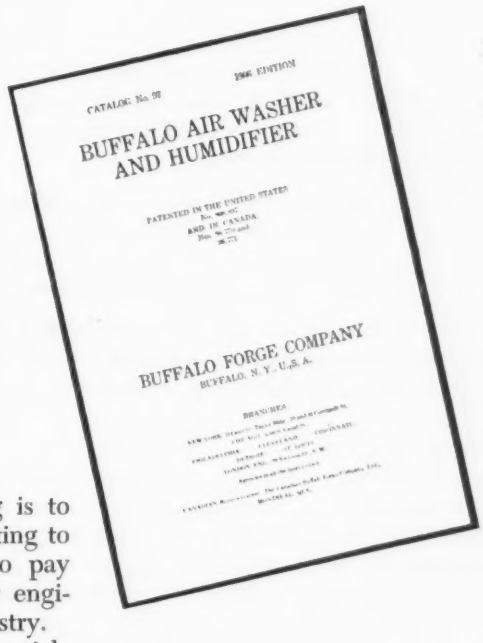
Providing air conditioning for the 31-story First City National Bank of Houston, Tex., will be three large centrifugal water chilling machines driven by Elliott steam turbines to provide a total of 3600-ton cooling capacity. 3045 units receiving conditioned air at high velocity from central air treatment stations will serve offices lining the exterior wall of the building.

Customarily located at the base of glass walls, units handling perimeter areas will be furred into the wall forming a sill of normal height. Installation costs should be lowered and maintenance simplified by using the free space underneath the unit for piping and feeder ducts. Except for the refrigerating machines, most of the mechanical apparatus (supplied by Carrier Corporation) will be located on the two uppermost floors.

Psychrometric charts—

a tribute to a pioneer

D. D. WILE
Member ASHRAE



The purpose of this writing is to record an historic event relating to psychrometric charts and to pay further tribute to a pioneer engineering-scientist of our industry.

The recently published article by this author, "Psychrometric Charts, Past and Present," gave credit to W. M. Grosvenor for originating a psychrometric chart. This chart was published in 1908 and thus preceded the Willis H. Carrier chart published in 1911. An exchange of correspondence with L. Logan Lewis, a pioneer co-worker with Mr. Carrier, now establishes that Willis Carrier produced, disclosed generally, and put to use, a psychrometric chart prior to 1906.

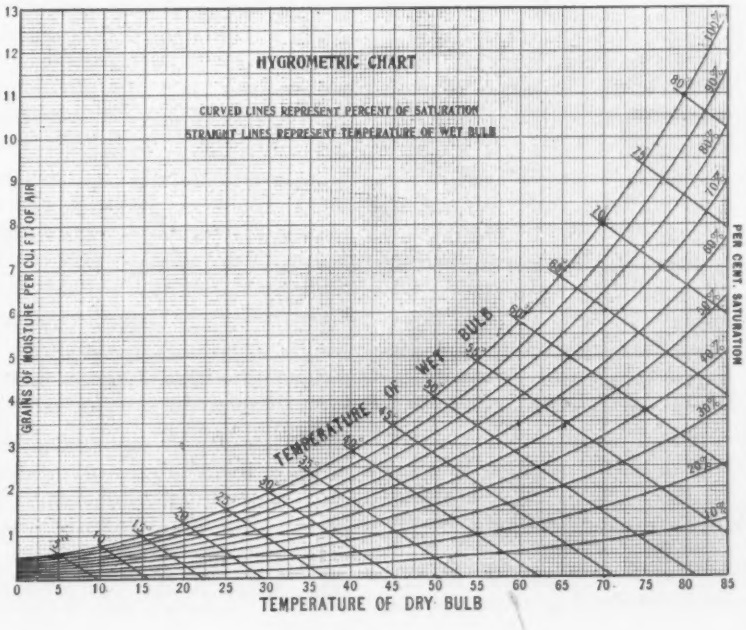
This chart, reproduced herewith, appeared in a Buffalo Forge Company Air Washer and Humidifier Catalog that was copyrighted in 1906. Mr. Lewis recalls that the same chart arrangement appeared in blueprint form with a date of 1904.

Mr. Lewis stated, in part, "Carrier called his 1906 chart a Hygrometric chart and plotted it from data obtained from Marvin's Psychrometric Tables, whereas the 1911 edition was called a Psychrometric chart and based upon Carrier's psychrometric formula."

It should be stated that the act of "publishing" an article requires that it appear in a recognized periodical, preferably available in library files. On this basis, the record indicates that Grosvenor preceded Carrier in publishing a psychrometric chart. However, this need not detract from the fact that Carrier actually produced a chart and put it to use several years before the appearance of Grosvenor's chart.

It is highly significant that both the Carrier charts of 1906 and 1911 included wet bulb lines which were absent from the Grosvenor chart. Thus, the Carrier chart broke a path for succeeding charts including those in general use today. Characteristically, Carrier used his early chart to educate others.

Psychrometric chart developed by Willis Carrier for Buffalo Forge catalog copyrighted in 1906. A note in the catalog indicates that the chart actually was drawn in 1905. It is similar to a blueprinted chart believed to have been produced by Carrier in 1904



D. D. Wile, Vice President of Recold Corporation and currently President of ASHRAE, authored "Psychrometric charts, past and present" in the August 1959 issue of the ASHRAE Journal.

Air conditioning

as applied to aircraft, missiles and rockets



ROBERT BERNER

Outlining the problems involved in air conditioning of aircraft, missiles, and rockets, author Berner compares them with problems encountered in the design of conventional air conditioning systems.

Compared also are the ground rules on which the designs are based. Discussion of heating and cooling loads is included. The development of air cycle and vapor cycle systems is traced and some of their limitations mentioned.

Also discussed are missile and rocket conditioning systems in connection with the mission to be accomplished, and problems involved in orbital and space flight.

To design any system requires a knowledge of the ground rules on which the design is to be based. These include values for external temperatures, interior compartment temperatures, humidity levels both in the external air and the compartment and ventilation air requirements.

Aircraft and missiles are mobile devices, subject to a wide range of temperatures, often within short periods of time. Fig. 1 indicates the range of temperatures encountered. These vary at sea level from –65 to +103 F. Commercial aircraft, subject to somewhat less rigid requirements, have their designs in general based on temperatures from –40 to +100 F.

Amount of moisture coupled with high design temperatures varies with specifications; however, for military purposes we use an 80 F dew point unless defogging is involved, in which case an 85 F dew point is used. These values result in air which is saturated at about 9 to 10,000 ft altitude; air above this altitude is assumed to be saturated. For commercial applications the values again are somewhat less stringent and the usual dew point is about 65 F.

These temperatures shown on Fig. 1 could occur, however, only if we were not in motion. In other words, they would be the values recorded during balloon flight. When we add forward motion it becomes necessary to include an additional factor; that of the ram temperature rise or aerodynamic heating resulting from the forward speed of the vehicle.

Fig. 2 gives some indication of the values involved. Here speed is indicated in terms of Mach number or speed of the vehicle relative to the speed of sound at that specific condition. In other words, Mach 1 indicates a speed equal to that of sound. Mach 2 indicates a speed twice that of sound, and so on. Looking at the ram temperature rise chart on this figure, we find that with the addition of these temperatures, and allowing for the fact that only about 90% of this ram temperature rise actually appears at the skin of the vehicle, at a speed of Mach 2 we are at a temperature level of about 250 F. This is the same as though the vehicle were flying in air at that temperature. Similarly for a Mach 3 flight speed we find that the temperature is between 600 to 650 F.

In establishing interior temperature levels the values selected are somewhat higher than those used for ground applications, and are usually about 75 to 80 F dry bulb. These values are used since the proximity of passengers to the aircraft walls tends to produce a cold wall effect. Since the cabins are sometimes pressurized to values somewhat less than sea level pressure, there is an increased tendency to evaporate body moisture and this also produces an additional cooling effect. In general, no attempt to control moisture during flight is made for the interior compartment. At altitude, the air on board the vehicle is dry and there is a gradual tendency to remove internally generated moisture. The addition of moisture to raise the humidity level would in most cases result in condensation on portions of the aircraft structure and resultant tendency for insulation to absorb this moisture in a wicking fashion. The net result would be increased aircraft weight. Extensive tests conducted in connection with this problem for some of the newer jet aircraft have indicated that, for the time periods likely to be encountered in flight, there is little effect on the body due to the low humidity levels as long as there is sufficient liquid available for replenishing body moisture levels.

In connection with military applications there is a different type of problem where wide variations in air temperature, wall temperature, pressure level, moisture level, air velocity, and clothing of the flight crew are encountered.

Here we resort to a means of computing the body storage index. It is possible to evaluate all of the above factors, and to combine these in such a way that we can determine whether the body is in thermal balance, or whether the body is increasing the amount of

Robert Berner is a Staff Design Engineer, Technical Development Department, Baltimore Div., The Martin Co.

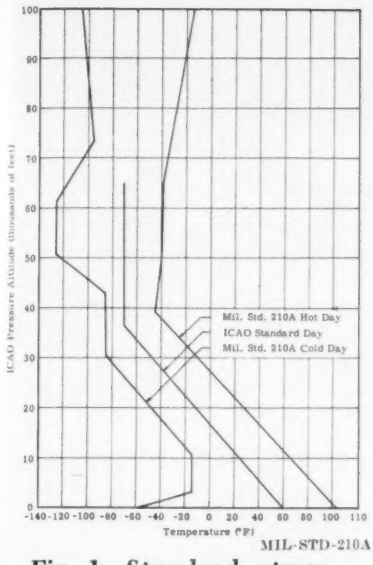


Fig. 1 Standard atmospheric temperature—Pressure altitude

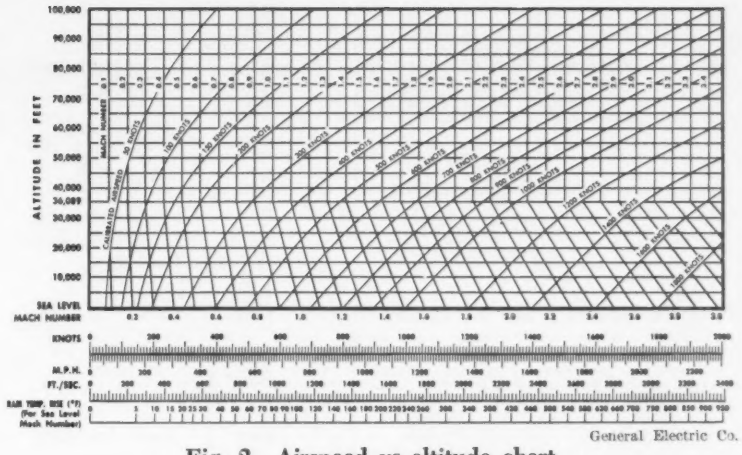


Fig. 2 Airspeed vs altitude chart

heat which is being stored. In the latter case, an increase in amount of heat storage results in a decrease in temperature tolerance level. Fig. 3 indicates the extent to which body storage is a factor in time tolerance.

In establishing ventilation requirements, large variations in both pressure and temperature of the air are encountered, and these produce wide variations in air density. For this reason, air requirements are expressed in terms of pounds per minute rather than in terms of cfm. Minimum ventilation requirements are usually one pound per minute of fresh air provided at sea level conditions, with additional air being provided by recirculation. Present designs usually employ larger air flows, since the air flow is usually determined by the cooling requirements rather than the minimum ventilation requirements.

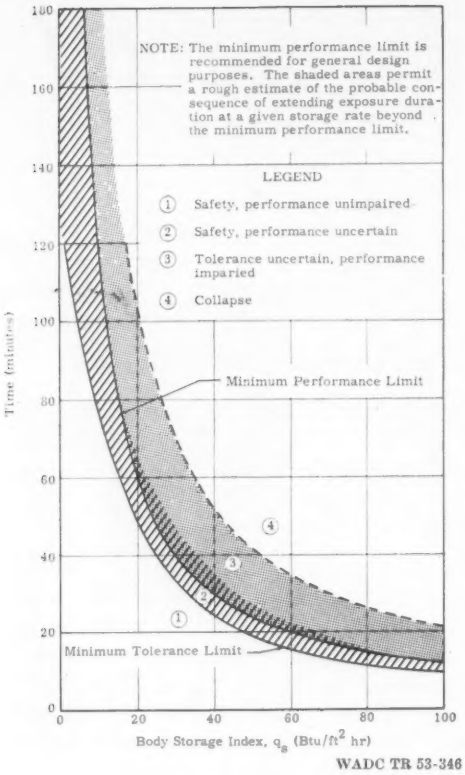
In addition to the previous items, it is also necessary to provide control of the pressure level. This is because humans are primarily sea level creatures. In order to sustain life and maintain body functions it is necessary to maintain a minimum oxygen pressure level inside the lungs. Without pressurization, as we increase altitude this lung oxygen level decreases. We reach a value in the vicinity of 18,000 to 20,000 ft at which body functions are impaired, and it becomes difficult or impossible to sustain life. We can correct this situation by the use of oxygen, but the problem simply transfers itself to a new altitude level in the vicinity of 35,000 ft and then the cycle repeats itself. Thus it is possible to breathe pure oxygen and still be unable to maintain a sufficient oxygen pressure level in the lungs to maintain body function. There is also an altitude level which is determined by the formation of gases in the blood stream, normally referred to as "bends." There is a rather significant increase in the occurrence of "bends" at altitudes just above 25,000 ft so that this level forms a practical top limit. In addition, if we went to higher altitudes we would reach absolute pressure level limit at about 63,000 ft, since at this altitude level the blood would boil at body temperature, and it would be impossible to sustain life.

COOLING LOADS

Calculation of the transmission load through the aircraft structure is accomplished in a manner similar to that for ground applications except for several basic points. Since the structure is comprised of metallic frames and skin it is necessary to consider the fin effect which results. In addition, external film coefficients are much higher in most cases than those for surface applications. Values of 30 to 50 Btu/hr/ft²/F are not uncommon. These, however, do decrease at altitude. Since we also encounter wide variations in outside temperature due to changes in aircraft velocity, it becomes necessary to consider the problem of transients in our heat transmission calculations.

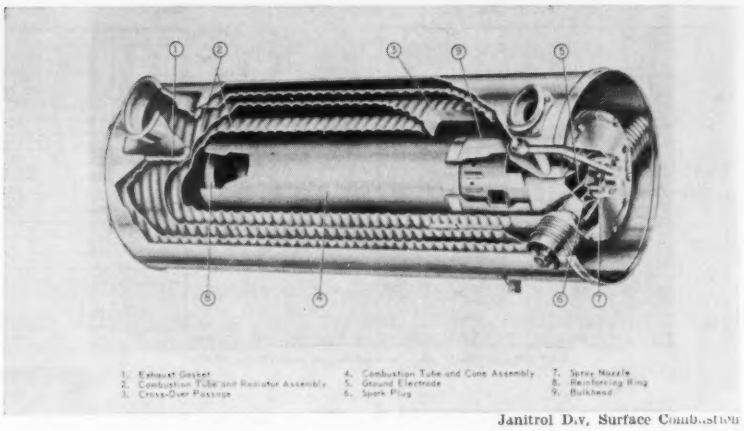
Solar loads primarily affect transparent areas since the solar input to the structure tends to be overridden by the ram temperature rise. Since we are at altitude we cannot conveniently depend on shadow effects of adjacent buildings, nor can we readily use external awnings. As a result, at an altitude range of about 50,000 ft the solar input becomes constant at about 430 Btu/hr/ft². Outside air infiltration is a problem on unpressurized aircraft. For pressurized aircraft, of course, the air leakage is from the cabin to the exterior and we have the problem of maintaining adequate sealing. It is interesting to note that cigarette smoking aids in this problem. There is a tendency for structural leakage to decrease with time as the deposit of nicotine tars tends to seal off the points of leakage. Personnel loads are also included and these are usually computed on the basis of the data available in the ASHRAE GUIDE, with allowance being made for increased activity level of crew personnel.

In addition to the above loads, we have a major problem area occurring in the defrosting and deicing of transparent areas, particularly in the case of fighter aircraft. High performance aircraft can come from high altitudes to low altitudes within an extremely short interval. In so doing they bring transparent areas which are at low temperature into areas of high humidity level. Use of thermal means for reducing this fogging or frosting produces a large additional heat load on cooling systems. For commercial applications we also encounter



WADC TR 53-346

Fig. 3 Performance and tolerance limits: transient zone



Janitrol Div, Surface Combustion

Fig. 4 Fuel burning combustion type heater

a large pulldown cooling load. Aircraft are frequently parked in a closed condition and exposed to solar loads for periods of time, and this results in the entire structure of the aircraft reaching an elevated temperature. The problem of removing this stored heat within a reasonably short period of time can have a major effect on cooling system design.

SYSTEMS AND EQUIPMENT

With early open cockpit type aircraft, the problem of ventilation did not occur. As the design was changed to close in the cockpit, the first systems naturally embodied provision for ventilation. As altitudes increased and lower temperatures were encountered, heating was required. Initial designs employed the use of exhaust gas heat exchangers, but these were subsequently replaced by fuel burning combustion type heaters. Fig. 4 is typical of this type of equipment. This heater is rated at 200,000 Btu/hr and is approximately 10 in. diam and 23 in. long.

With the addition of pressurization on aircraft, an additional source of heat was acquired in the compression heat of the air as it was compressed from ambient to cabin conditions. However, this additional heat produced a significant problem at low altitude and gradually led to the need for cooling systems. About this same time period the use of a jet powered aircraft entered the picture, and with the availability of the jet engine we had a source of high pressure air which could be used to power a cooling system. As a result, initial system designs moved in the direction of air cycle systems in which the air itself became the working refrigerant.

Several types of air cycle cooling systems have come into general use. Fig. 5 shows a "simple" air cycle system. In all air cycle systems air is bled from a compression source, in this case shown as a jet engine. The air is then passed through an intercooler to remove the majority of the heat of compression, and is then expanded through an air turbine. The turbine does mechanical work and the resultant heat energy is extracted from the air. The air then leaves the turbine at a reduced temperature level and is available for cooling. Air supplied to the intercooler to remove the heat of compression is drawn from the outside, and the flow is aided by the use of the fan which has, as its energy input source, the power provided by the cooling turbine.

The cooling capacity of a system of this type depends basically on the available ratio of inlet to outlet pressure at the cooling turbine. With increase in jet engine performance, the system performance of the simple air cycle proved adequate for many military applications. However, for commercial applications in which the available power source was a compressor driven by the reciprocating engine the available turbine pressure ratio was quite limited, and this proved to be a major limitation on system capacity. As a result the so-called "boot-strap" system was developed. Fig. 6 shows the arrangement of this type of system. Air is drawn from the compressor source and passed over an intercooler to remove the heat of compression. It then passes through a second stage of compression and through a second intercooler which removes the additional heat of compression. It is then expanded in the cooling turbine.

Because of the additional pressure provided by the second compressor, the pressure ratio across the cooling turbine becomes higher, and the available cooling is also greater than with a simple system. The output of the cooling turbine is used in this system to provide the power input for the second stage of compression. It is necessary to provide cooling air across the intercoolers through the use of ram air in flight. In order to provide operation for a system of this type on the ground it is necessary to also add fans or similar means for providing this intercooler air flow during non-flight operation.

Air cycle systems are, of course, limited by the ram temperature

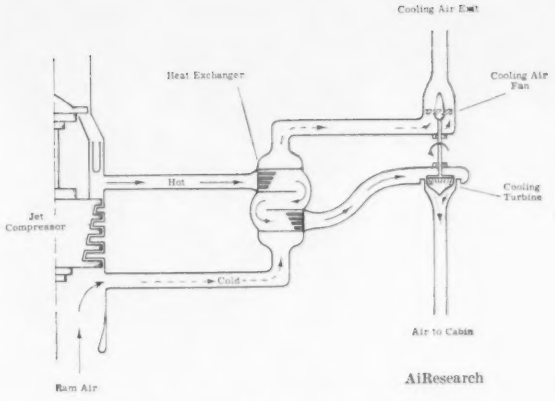


Fig. 5 Simple air cycle system

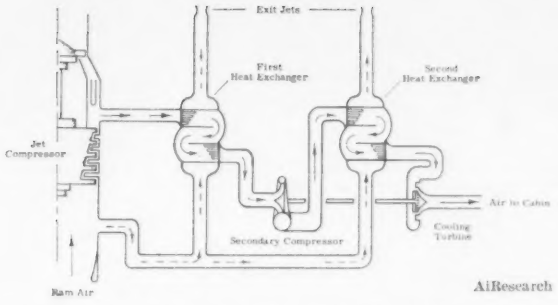


Fig. 6 Arrangement of the "boot-strap" system

rise, and at high speeds the temperature level is such that it is impossible to produce a sufficient temperature drop through the system to provide air at the turbine outlet at a usable level for cooling. An additional system has been developed employing the use of an evaporative type water boiler in series with the intercoolers. Fig. 7 shows this arrangement as applied to a simple type system. In this system an additional heat sink is provided by boiling off the water and absorbing the latent heat of vaporization. This can be accomplished at low temperature levels at altitude.

SMALL SIZE, HIGH POWER

Any equipment for use in air cycle system embodies the use of high speed rotating machinery. Fig. 8 shows the type of system which was used on the Martin XP6M-1 aircraft. It is a modification of the simple air cycle. The first pass of the intercooler, shown in light color, is made of steel because of the temperature levels involved. An indication of the size of this unit may be judged from the fact that the intercooler is approximately a 16-in. cube. The unit weighs less than 100 lb and has a cooling capacity of approximately 4¼ ton. Its turbine speed at normal rated design point is approximately 78,000 rpm.

It should be kept in mind that air cycle systems of this type are not necessarily economical on power. The specific unit here described requires about 19 hp per ton at its rated design condition. This hp is supplied by the high pressure air.

Since air cycle systems require operation of the engine or a ground source of high pressure air at high airflow rates, there has been a trend in the case of commercial aircraft to use some other means of cooling. Operation on the air cycle systems under ground conditions can require fairly high engine speeds for reciprocating engine applications. The alternate use of a separate ground air conditioning unit, while feasible at major terminals, becomes economically impractical where a large number of intermediate stops are involved. For these reasons vapor cycle systems entered the picture. The early DC7 installation required the use of a vapor cycle system in addition to the basic air cycle system embodied on the airplane. The vapor system capacity was approximately five ton and was in addition to an air cycle system also having about a five-ton capacity. The Lockheed Electra also involved a similar type of thinking, using a system which has a vapor cycle system capacity of twelve tons. The larger jet aircraft such as the 707 and DC8 employ dual systems each having a rating in the 12 to 13-ton range thus giving a total installed capacity of 25 to 26 ton.

These vapor cycle systems are conventional in design but generally require a somewhat higher compressor hp per ton since condensing temperatures are usually higher than those for ground applications. The compressors used on the systems are driven either by 400 cycle electrical power, or in the case of the DC8, by an air turbine supplied by bleed air from the jet engine or a ground source. Air supply for cabin pressurization in these instances is usually provided by a separate turbine driven cabin air compressor.

Associated with all these different types of systems are a number of common problems which differ in many respects from similar problem areas in ground application. The problem of water separation, particularly in the case of air cycle systems, is significantly different. Since the air cycle turbines are high speed rotating machines, condensation occurring in the system will be discharged from these units in the form of a truly finely divided fog. It is usually necessary to precipitate this fog in order to get it into droplet form before we can adequately provide moisture removal. Associated also with air cycle systems is the problem of distribution of high temperature high pressure bleed air from the jet engines. In recent high performance aircraft, bleed pressures may run in excess of 200 psi at temperatures above 800 F. Distribution of this air is a problem not unlike that of the distribution of high pressure high temperature steam in normal power plant or heating practice. It is necessary to provide adequate expansion for ducting in this temperature range. Velocities in these ducts are also in the order of 200 to 300 fps. Since we are unable to absorb the weight of conventional high pressure piping using heavy flanges, it has been necessary to develop lightweight stainless steel ducting using thin wall high strength tubing, and to develop associated means of assembly of such ducts.

The problem of air distribution is one of attempting to supply a large amount of air in a small space and at the same time mini-

mize drafts. This is a probable major development item in any design. Cabin pressure is usually controlled by allowing all air to exit from the cabin at one point and then providing an automatically controllable throttling valve at this location. In air cycle systems for military applications, temperature control systems encounter changes as high as 60 to 70 deg per sec in the supply air. Temperature control systems usually are electronic or pneumatic. Pneumatic controls are used extensively with air cycle systems since a source of pneumatic pressure is readily available.

As we proceed to higher altitudes and higher speeds we find definite limitations occurring on the above types of systems. In addition to the limitation of ram air temperature, the air cycle systems are limited by lack of air at altitudes. With the low ambient pressures, the available bleed pressure from jet engines decreases, and since the cabin pressure must be held at a fixed level because of physiological reasons, the available pressure ratio for cooling turbines becomes quite limited. The use of vapor cycle systems in high speed is limited due to the critical temperature of refrigerants when operating at high condensing temperature levels. Under such conditions it then becomes more practical to avoid the use of outside air wherever feasible, and to bring in only the amount needed to provide pressure control. The tendency is then toward the use of an internal heat sink embodied on the vehicle itself. Air or liquid recirculating type systems are used to transfer the heat from the heat source to the heat sink. In the event that the temperature level which must be maintained for personnel or equipment use is below that at which the heat sink can operate, a vapor cycle system may be employed as a step-up device to dispose of the heat to the heat sink at the condensing temperature level.

With the use of extreme altitudes pressure suits become mandatory since failure of the cabin could result in instant death. One difficulty with the use of pressure suits lies in the fact that they must be designed, of course, to be impervious to air loss and they are thus automatically impervious to body moisture. In order to prevent accumulation of body moisture and body heat it is necessary to employ a ventilating garment underneath the pressure suit. Fig. 9 shows one type which is developed for this purpose. It becomes a short step, then, from design of advanced type systems of these kinds to the design of a sealed cabin which is basically required for the use of high performance aircraft or for space applications.

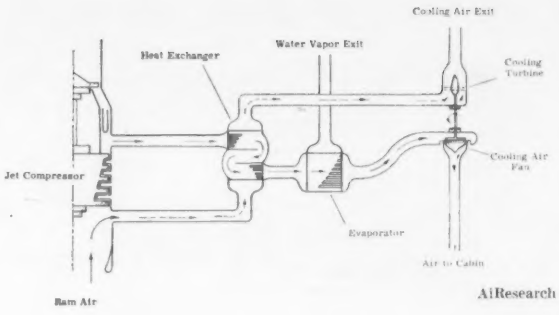


Fig. 7 Arrangement of a simple evaporative type system

MISSILES AND ROCKETS

In general, missiles or rockets fall into two basic categories; first, the surface to surface missiles which are launched from the earth surface to an earth target and secondly, the air to air missiles which are launched from an air vehicle to an air target. Variations from these basic types exist in the case of surface to air or air to surface type missiles.

The surface to surface types range from the high subsonic air-breathing types, such as the Mace and Snark, to the ICBM ballistic types. The aircraft types of missiles have performance which is similar to that of aircraft and the cooling systems tend to follow aircraft design. The ballistic types have a flight trajectory in which a large portion is outside of the earth atmosphere. They are subject to high heating rates following launch for short periods of time. The portion of the missile which returns is subject to extremely high rates during the re-entry period. Air to air type missiles are usually characterized by high speed missions of short duration. The surface to air or air to surface missions tend to follow patterns which are similar to the similar portions of the basic missile types.

Since missile types and designs are varied, the type of conditioning systems employed also varies and it is more convenient to discuss the systems in terms of the problems encountered during each portion of the trajectory.

Conditioning problems occur during the following phases of operation:

Ground storage. Missiles are usually subject to ground environmental problems for extended periods of time, and the general attempt is made to design the missile so that it can stay in this environment with a minimum amount of conditioning. Equipment on the missile in this phase is usually not operated.

Ground checkout. During this phase the missile is made ready for use and frequently the electronics equipment is subject to functional or adjustment types of checks. The problem is primarily one of removal of the internal heat which is generated. This is usually accomplished by circulation of air or liquids through the compartment or the equipment.

Launch. Following launch, the missile is usually subjected to high heating rates for fairly short periods of time. In the case of ballistic type applications in which the various stages of propulsion are separated at time intervals, the equipment must be cooled for a relatively short period of time. Attempts are made to employ thermal lag wherever feasible, or to prevent heating through the use of insulation and shielding. If this is insufficient then additional conditioning may be provided through the use of techniques embodying the evaporating of such fluids as water.

Re-entry. For those portions of the missile which must re-enter the atmosphere, some protection against the high heating rates is usually accomplished by the use of heat sink material or ablating material. Ablation may be considered as a condition in which the outside structure of the re-

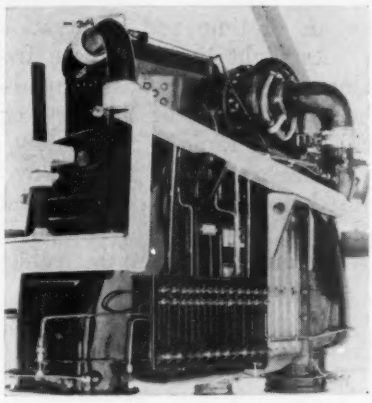


Fig. 8 System used on the Martin XP6M-1 aircraft



Fig. 9 Ventilating garment for use underneath a pressure suit

entry body vaporizes, absorbing the latent heat of vaporization of the material. Internal equipment which must function during the re-entry period is protected by radiation shielding and insulation, and evaporative cooling may be supplied if the shielding is inadequate.

Captive flight. For air to air type missiles in which captive flight involves high speed portions of the mission which exist only for short time durations, the approach is to attempt to design the missile to endure the environment and provide sufficient internal heat sink or thermal lag to protect the equipment. With increase in flight time at high speeds this problem will become more severe, and in the event that thermal lag or similar protection is inadequate, it will be necessary to provide additional insulation and possibly some means of evaporative cooling for the equipment.

Active flight. Since the active flight time for air to air type missiles is usually short, again the design is usually based on time lag, with insulation or evaporative techniques available if required.

Orbital flight. The problem of cooling during orbital flight is intimately involved with the design of sealed and space cabins and will be discussed in that connection.

SPACE CABINS

With the advent of completely sealed cabins several additional problem areas not previously mentioned are encountered. The first of these is control of the composition of the atmosphere inside the cabin. It is likely that the initial cabin pressure levels which will be used will approach the 25,000 ft cabin altitude limit previously mentioned in order to keep overall weight low. In order to avoid the necessity for the use of an oxygen mask or similar type of equipment, it will be necessary to provide an atmosphere in which the oxygen content has been increased. Oxygen levels will then be above 50%. Coupled with this, of course, will come the potential fire hazard problem. Work is being done in this problem area at present in order to establish the design limitation. Present indications are that problems which may arise can be engineered or designed out of the system with little difficulty. Since individuals also produce carbon dioxide in the normal breathing process it will be necessary to remove this in order to prevent accumulation, with adverse physiological effects. For the flight time duration involved, the most likely way of handling this problem will be to absorb the carbon dioxide in a bed of the lithium hydroxide, using a recirculation air type of system. As ability to place increased weight into orbit improves, pressure levels in the cabin will undoubtedly approach sea level values.

Another major problem area is in the control of humidity. Closely related to this is the control of internal temperature to limits which will prevent increase in body moisture production activity, in order to provide a limitation on the amount of moisture which must be removed. Removal of moisture can be accomplished through the technique of condensing the moisture on the cold surface, similar to that used in present ground applications, and then providing a mechanical means of removal. An alternate way of removing moisture would be through the absorption of the moisture in an absorbent bed such as anhydrone. The use of absorption beds for carbon dioxide and moisture removal adds to the size of the cooling job because of the chemical heat of reaction which occurs in the absorption process.

For unmanned flight vehicles, temperature control has been accomplished largely through the use of passive coatings on the surface of the vehicle. It is possible to provide a surface condition which will reject heat from the vehicle at the surface temperature level and at the same time will reflect solar heat, thus minimizing the solar heat absorbed. Such a technique is feasible where the internal heat generated is small and where the surface of the vehicle is relatively large in comparison to the heat generated.

For system involving human occupancy and larger heat loads it is likely that evaporation techniques will be used. Heat exchange surface will be provided in a recirculation air system. Water can be fed to the exchanger, and flashed at the low pressures involved into steam, picking up the heat of vaporization. An alternate means would be to provide a flooded boiler type of design in which the evaporation temperature is controlled by throttling the discharge line. As cooling loads and flight durations increase, it will be necessary finally to resort entirely to the use of radiators, since radiation is the sole means of heat exchange under orbital operating conditions.

One of the major problems which will be encountered in application of systems for sealed space cabins will be the problem of weightlessness. The vehicle is in orbit primarily because of a balance between the force of gravity and the tendency for centrifugal force to cause the vehicle to go on out into space, and this results in the weightless condition for items within the vehicle. Under a situation of this type it will be necessary to provide a positive means of circulation for removal of air. For example, the carbon dioxide which is exhaled would remain essen-

tially in the vicinity of the face unless dispelled by positive air circulation. Again, with application of boiling, the basic reasons that a heated bubble rises from a heated surface is due to difference in density of the fluids and the bubble. Since the absence of gravity eliminates this factor, there is no reason for a bubble to move away from the heated surface. It will remain on the surface and will tend to grow in size until it blankets the surface and burnout occurs. The problem of weightlessness is further complicated by the inability to provide a means of testing at sea level, or in flight, for extended periods of time and observations.

As flight times increase from hours or days into weeks or months the arrangement of these systems will change rapidly. Ultimately, it will be necessary to employ a closed ecological system in which all items necessary to sustain life are manufactured on the vehicle.

To practical solar heat

through reflective conical collectors retarded heat flow storage heat pump auxiliary source



HENRY E. VOEGELI

Sooner or later, it will be wise for us to learn how to make use of the heat of the sun.

Availability of solar heat – In exploring methods for capturing the heat of the sun certain limitations and circumstances must be recognized. Some of these are unalterable, other can be modified. A constant limiting fact is that the sun sends only about 7.12 Btu per sq ft per min to the outer reaches of the earth's atmosphere. In passing through to the earth's surface, much of this heat is lost by irradiation and refraction. Roughly, 4 to 5 Btu may get through, under good conditions.

The Langley unit is a standard measure of solar heat and equals one gram calorie per sq cm per min multiplied by the solar constant 1.94. In the Summer Solstice, the longest day of the year, the solar heat received at the surface of the earth in the area of New York City is approximately 750 Langley days, while in the shortest day of the year, the Winter Solstice, the corresponding value is about 200 Langley days. The average value during eight months in summer is 600 Langley days per sq ft per day. This amount divided by 12 for the sunshine hours of the day, leaves 50 Langley days per hour, the product of which, when multiplied by 3.68 equals 184 Btu received per sq ft per avg sunshine hr. With this base information it is now possible to think of design.

Stepped up temperature—The natural temperature of absorbed solar heat is of little use, because it is too low for power, for heating or economical storage. It is therefore expedient to obtain a higher temperature by concentrating the sun's rays to a point. This can be done with a lens or parabolic reflector – but more satisfactorily with a reflective conical collector. A temperature of 400 to 500 F in the focal area is desirable.

Heat storage equipment—Heat that is collected in this manner can be stored in tanks of water underground for heating when winter comes, and in tanks in a generating plant for immediate use in making steam or electric power. The tanks for power need to be strong and would have heavy insulation, while those for heating can be ordinary fuel oil tanks buried underground, and encased in reinforced concrete. The function of the reinforced concrete is to provide strength to withstand the great pressure ranging up to 400 psi, and the alkalinity of the concrete is required to prevent the steel tanks from rusting. When the water temperature in the buried tanks is 200 F and above, the surrounding earth becomes powder dry and serves as an excellent insulator for retaining heat. Because of this the relatively high temperature heat of the water in the tanks will penetrate only a few inches into the ground outside the concrete casing.

Size of tanks – The design concept can best be illustrated by a hypothetical problem, thus: Consider the heating cycle in a house having

Henry E. Voegeli is Development Engineer, American Brass Company. The author has recently addressed several ASHRAE Chapters in regard to ways in which he anticipates that heat and power may be derived from the sun and is currently obtaining test data from an installation in a New England home with equipment similar to that herein described.

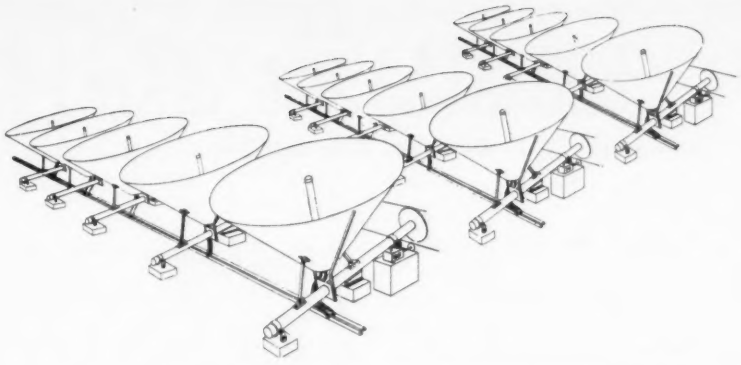


Fig. 1 Coordinated power positioning of concentrating reflectors can bring high intensity solar heat availability

a heat loss of 70,000 Btu per hr with a 70 F temperature differential in a climate with a 6000 deg day heating season. 70,000 ÷ 70 = 1000 Btu per deg hour, or 24,000 Btu per deg day; 24,000 × 6000 = 144,000,000 Btu required for the 6000 deg day heating season. To store that much heat in water under a house would be uneconomical. A better way is to use, at most, two 6000 gal tanks which with water at 470 F would hold 40,000,000 Btu. The remainder of the required heat to come from the earth with the help of a heat pump.

Long term heat storage – It is intended that most of the heat would be collected in summer from March to November when solar heat is the more plentiful. To collect heat in fair weather in winter may be profitable, but it does not compare with the amount of heat that is available in summer. For instance, the heat received from the sun on June 21 is about 3¾ times the amount that is received on December 21.

It may seem doubtful that heat can be stored for so long a time, hence, this explanation: A prolonged study at the University of Connecticut proved that the penetration into the earth, whether it is used as a heat source or heat sink, is surprisingly little, particularly with the latter because its drying effect reduces the conductivity of the ground. What is most important in this case is the retarded heat flow due to the insulating effect of ground that is devoid of moisture. By way of practical illustration – a 4000 F thermite bomb can be rendered harmless by placing it in a pail of sand. Because of retarded heat flow we can have natural ice in August which was harvested in February. Similarly, the ice in Ice Gulch, Randolph, N. H., has not melted in thousands of years even though it is surrounded with temperatures far above freezing the greater part of the year. To repeat, delayed action is what makes heat storage in the ground possible.

It was found at the University of Connecticut that even with moist earth the flow of climatic heat is quite slow. This can be explained as follows: According to the sun the height of the heating season is on the 21st day of December, but actually, because of the residual summer heat in the ground, the mid-point of the heating season is delayed until February first. What is more, the lowest temperature at the five foot level below ground does not occur until March 1st. By then spring is already having its affect in reducing the heating load. The purpose here is to retard the heat flow so as to obtain conditions similar but inverse to those at Ice Gulch.

Construction, landscaping, planting and orientation – A solar house that is to have year-round comfort conditioning by way of heating and cooling from the heat of the sun, should be designed to take advantage of every structural or horticultural and landscaping device to reduce the heating and cooling load. First, one should "set the house close to the ground"–a 6-in. underpinning is sufficient. The fill against the foundation, 3 ft deep, should be of sand or gravel or other nonhygroscopic material so as to minimize the loss of heat through the foundation wall to the frozen ground.

Thermal insulation is of greatest importance, and the blocking off of direct sunlight by overhanging cornices and other shading in summer is desirable. Windows should be about 3 ft above the floor, except, possibly in a solar wall on the south side. Additional benefits are available through orientation and the planting of trees and shrubs. By these means the house is sheltered from the wind, and the trees can form a pocket to receive the warming rays of the winter sun. In summer the trees provide a cool shade and sweeten the air by the evaporation of moisture.

Size of collector for heating and cooling – The solar heat collecting equipment for heating and cooling a solar house having a heating load of 70,000 Btu and a cooling load of 40,000 Btu may consist of a 24 ft diam conical solar heat collector, if the cooling is to be done with the heat of the sun by the absorption system of refrigeration; otherwise an 18 ft diam collector will suffice for charging the tanks of water with heat. Automatic electronic controls are necessary to train the collector constantly on the sun, and a thermostatically controlled water circulator is required to deliver the heated water from the boiler in the collector to the storage tanks under the building. The water in the tanks is intended to be heated and circulated until an even temperature of about 470 F has been attained.

Heating – With the addition of a separate closed system for radiant panel heating and with a simple heat exchanger, the system is ready for the heating season. In the beginning the heating system draws on the high temperature heat in the tanks, and continues to do so well into the heating season and until the temperature of the water gets to 100 F, at which time the heat pump cuts into service. This phase continues until the water in the tanks gets to 30 F and slush ice is formed.

At that point a benefit is de-

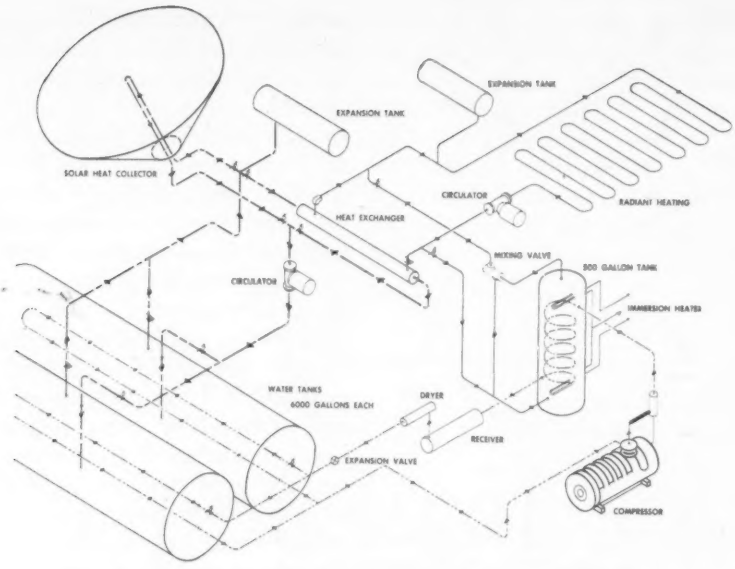


Fig. 2 How solar heat derived from a concentrating collector may be used for radiant heating with heat pump and off-peak electricity auxiliaries

rived from the latent heat of fusion. By now the sensible heat in the surrounding mass of concrete and from the earth immediately beyond has been absorbed, with the result that moisture has returned again to the now chilled area, improving the thermal conductance of the ground and delivers warmth from the earth to within reach of the heat pump.

Electric immersion heaters in a small storage tank for house heating in conjunction with the operation of the heat pump, and for heating domestic hot water can be put into service during off-peak periods near the end of the heating season if found economical.

Cooling – The cooling system can be conventional, but the condition under which the cooling season with this type of installation begins is most unusual – the season starts with 40 to 50 ton of ice in the tanks. One tank is intended to be used for condensing refrigerant during April and May, then to be put to work storing next winter's heat, while the second tank is connected up as a condenser for the cooling system. In the later part of the summer season some additional capacity for condensing may be required. Under these combined conditions the coefficient of performance for the heat pump in both the heating and cooling cycles should be sensational.

Power – For steam and electric power a multiple arrangement of conical collectors 50 ft diam would be quite suitable. The area of boiler surface in the collector, compared to the collector area (normal to the sun) should be in the proportion as 1 is to 40. The boiler, simulating a cylindrical pistil in the center of the cone, if made 4-in. diam, will intercept all of the reflected rays of the sun. The 4-in. dimension is determined by the angle of the solar rays. They arrive at the reflecting surface at a converging angle of 32 minutes, due to the relatively large diam of the sun.

These rays are reflected in like manner except that they open at an angle of 32 minutes, theoretically requiring a larger boiler and greater precision in shaping the cone as the diameter increases. The 50 ft size is in good scale and lends itself to economical construction and safe control during wind and storm.

The surface of the copper boiler is oxidized and burned to the dead black, and the reflecting surface of the collector can be of polished aluminum, polished copper or silvered glass mirrors. None is ideal; aluminum becomes scratched and dull from cleaning, and copper tarnishes too quickly. Lacquer would help but it would have to be renewed every year at considerable expense. Mirrors are probably the most practical as they require a minimum of care. It is recognized that they are the least efficient because the sun's rays must pass through the glass twice to be reflected by the silvering which is necessarily on the back of the mirror.

Estimated output–Theoretically, a 50-ft cone with its 1956 sq ft of collecting area (normal to the sun) multiplied by 184, (the average available radiation in Btu) has a capacity of 359,904 Btu per hr, which when divided by 33475 has an equivalent of 320 lb of steam or about 4 hp of steam turbine generated electrical energy per hr.

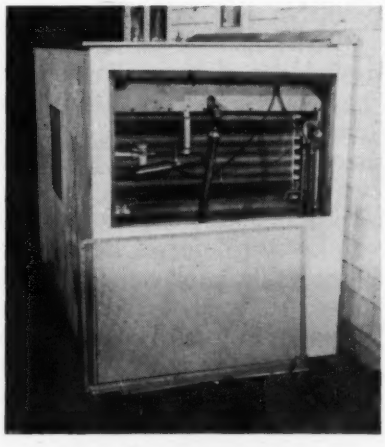
HEAT PUMP

(*Continued from page 59*)

by electric heaters is a desirable heating plant from the user's point of view.

5. Minor problems occurred with the starting mechanism of the motors and with the defrosting system. These are directly related to the items of equipment used and are not necessarily characteristic of all heat pumps.

Fig. 3 Evaporator "house" with a protecting screen removed. A similar evaporator coil is in the far end with the blower between



ACKNOWLEDGMENT

Appreciation is expressed to Professor H. J. Dana, Engineering Experiment Station at Washington State University, for assistance in initiating this project and for general guidance throughout its duration. Thanks also are due to Harold U. Wright of the Washington Water Power Company for his interest in this work and suggestions on the manuscript.

BULLETINS and CATALOGS

High Pressure Air Conditioning Equipment. Of interest to architects, engineers and others concerned with the selection and specification of equipment for multi-storied applications, four-page Bulletin HCD 341.04 contains extensive product and engineering data. Illustrations, dimensional drawings, a table of dimensions and nominal rating tables are included. Equipment discussed in the booklet is blow-through type, engineered for hot and cold duct operation at static pressures from 2½ to 8 in. Nine models are offered for DX, cold water, hot water and steam, in a range from 3500 to 27,000 cfm.
Drayer-Hanson Div, National-U.S. Radiator Corporation, 3301 Medford St., Los Angeles 63, Calif.

Oil-Fired Boiler. Introduction of the Custom Mark II Boiler is announced in four-page Bulletin 6290. Features cited for the unit are: "VoluMetric" firing system leaving no unburned residue in the form of smoke, soot or carbon; combustion flow fan controlling within precise limits the amount of air introduced into the combustion chamber and which seals the heat within this chamber between burner operating periods, preventing standby loss; and elimination of the need for a conventional chimney, with only a small exhaust pipe necessary.
Iron Fireman Manufacturing Company, Cleveland 11, Ohio.

Condensation Pumps. Explaining and illustrating this manufacturer's six basic condensation pumps, 12-page Bulletin CP-600 presents design features, general specifications, engineering data, dimension drawings, construction and operation details and a check list to follow in selection of a pump. Data and drawings pertain to both single and duplex units.
American Air Filter Company, Inc., 215 Central Ave., Louisville 8, Ky.

Assembly Fasteners. Providing design engineers and others with information on this company's line of self-retaining assembly fasteners is eight-page Bulletin 2469, which presents a wide range of metal fasteners for a variety of equipment. Among the new items introduced is an expanded line of standard fasteners for use in the manufacture of appliances, automobiles, aircraft and ships; featured are custom designed fasteners for special installations of panelling, tubing, wiring and sheet metal fabrication of all kinds. A special section illustrates the company's facilities for experimental design, prototype and new product fastener engineering.
Robin Products Company, 27027 Groesbeck Hgwy., Warren, Mich.

Flexible Couplings. Compensating for parallel and angular misalignment as well as free end float, the couplings described in 52-page Catalog 60 are cited as offering freedom from backlash, torsional rigidity, smooth continuous drive with constant rotational velocity and visual inspection while in operation; having no wearing parts; needing no maintenance or lubrication; and as being unaffected by high or low temperatures. Product illustrations, guide to selection, and dimensions are included.
Thomas Flexible Coupling Company, Warren, Pa.

Coil Catalog. Extensive information on all water and direct expansion refrigerant coils is contained in 28-page Catalog 5559, which includes water, direct expansion and booster coil specifications and covers construction features. Also presented are physical and performance data charts, selection of water heating and cooling coils, mean effective temperature difference chart, determination of final dry bulb temperature and direct expansion coil surface temperatures, selection of direct expansion coils, direct expansion cooling coil capacity tables, psychrometric chart and total heat table.
Young Radiator Company, Racine, Wisconsin.

Aluminum Strip Ventilator. Installing either flush or recessed, the ventilator described in Flyer 273-L comes in eight-ft lengths, is cited as fitting any type of soffit in roof construction of any pitch, and provides 35.2 sq in. of free area per eight-ft length.
Air Control Products, Inc., Leigh Building Products Div, Coopersville, Mich.

Translucent Building Panels. Designated Sanpan, this is a structural sandwich building panel offering full translucency with a complete range of color skins and inserts. Among its applications are curtain walls, exterior wall panels, interior partitions, roof panels, skylights, room dividers and translucent roofs for covered areas. Eight-page Bulletin 3e/Pa provides manufacturing information, specifications, data and product illustrations.
Panel Structures, Inc., 45 Greenwood Ave., East Orange, N. J.

Pyrometer. Standard range of this portable indicating pyrometer is from −40 to 200 F, with a selection of interchangeable thermocouples available for various temperature measurements. A reference temperature block is built into the instrument, and the thermocouple is extended so that actual reference temperature is the block temperature, providing a convenient means for setting the reference temperature. Bulletin 2146C, four pages.
Illinois Testing Laboratories, Inc., 420 N. LaSalle St., Chicago 10, Ill.

Walk-In Space Chambers. Chambers including a variety of specifications for the simulation of extreme conditions of space, such as altitudes to 1.5 million ft., temperature from −150 to 2000 F, humidity to 95%, rainfall to 24 in./hr, ram air flow, varied altitude climb and dive rates, solar radiation to 140 watt/sq ft, radiant heat assemblies, dissipation of live or static loads and vibration accommodation, are described in four-page Bulletin M-959.
Tenney Engineering, Inc., 1090 Springfield Rd., Union, N. J.

Diaphragm-Type Expansion Tank. Applicable to all hydronic systems, the Extrol unit is cited as eliminating water-logged tanks and causes of air troubles, providing a flexible diaphragm between water and air in the system so that they cannot come in contact. Diagrammatic illustrations, tabulation of specifications and dimensions and details of installation methods are included in a four-page bulletin.
American Tube Products, Inc., West Warwick, R. I.

Spherical Roller Bearings. Added to this manufacturer's line of bearings, which now includes both ball and roller types, these roller bearings feature raceways and rollers specially finished to afford smooth working surfaces. Designed with a double row of large-size rollers to accommodate excessively heavy radial and shock loads, they utilize a single spherical outer raceway to permit compensation for shaft misalignment

(Continued on page 72)

in any direction, either initially or dynamically under load. Accurate roller guidance is assured by a heavy center guide flange between the two inner raceways, asymmetric roller design and heavy machined-bronze, land-riding retainers. Bulletin 113, sixteen pages.
Hoover Ball and Bearing Company, 5400 S. State Rd., Ann Arbor, Mich.

Gas Burners. Carrying size and operation specifications on the "Gun Heat," "Contractor," "Teletube" and "Spread Heat" series of burners, with illustrations of the different flame patterns produced by each, is this flyer. Dimensional drawings and specification charts are provided.
Barber Manufacturing Company, 1052 E. 134th St., Cleveland 10, Ohio.

Silencers. Technical data on the design and application of packaged unit silencers for air conditioning and ventilating systems is included in this catalog.
Industrial Acoustics Company, Inc., 341 Jackson Ave., New York 54, N. Y.

Terminal Blocks, Solderless Connectors and Cable and Conduit Fittings. Terminal blocks are available in preassembled lengths of 20 snap-fit contact sections to make blocks with any required number of circuits, eliminating need for terminals or lugs, hidden contacts and circuit markings. Three types of contact sections can be combined in one block. Connectors described in 12-page Catalog 76 are splice caps, nylon insulators and all-copper lugs. Terminals are of electrolytic copper with high corrosion resistance and are for both stranded and solid wire. Conduit bushings are available from ½ to 6 in.
Buchanan Electrical Products Corporation, Hillside, N. J.

Residential Evaporator. Available in five sizes, of 2, 3, 4, 5 and 7½-ton capacities, Model BH-2 is the subject of Flyer 181. Listed are features and capacity and physical data.
Bohn Aluminum & Brass Corporation, Danville Div, Danville, Ill.

Gasoline-Driven Electric Plants. Listing this manufacturer's entire line of gasoline engine-driven electric generating plants is four-page Bulletin F-145. Three compact, completely self-contained generator sets providing an independent source of electricity for primary, standby, portable or mobile power are discussed in detail, with specifications for engine, generator and controls outlined to facilitate selection of the proper type of plant. A chart of representative models within each series lists such details as capacity of the plant, voltage, model number, type of engine, starting method, dimensions and weight. Air-cooled models are listed in sizes ranging from 500 to 10,000 watt, water-cooled units from 10,000 to 170,000 watt.
D. W. Onan & Sons, Inc., 2515 University Ave., S.E., Minneapolis 14, Minn.

Room Air Conditioners. Electromagnetic dirt filter, automatic filter signal, simple dial controls, automatic thermostat, two-directional cooling, fresh air and exhaust vents and two-speed fan are features of the Masterpiece Series presented in 6-page Folder RC-1867. Models in the line are illustrated, capacities are given and controls are described.
American Motors Corporation, Kelvinator Div, Detroit 32, Mich.

Air Meters. Containing in its four pages descriptions and illustrations of the various types of air velocity measuring instruments and probes, Catalog 170 presents typical applications and full-size renderings of the dial faces. Models described have ranges from 5 fpm to 200 mph.
Hastings-Raydist, Inc., Hampton, Va.

Impervious Graphite Processing Equipment. Revised to include the latest equipment, as well as current costs, 32-page Bulletin 249-2 contains product illustrations, lists standard models available and provides the approximate cost per sq ft of heat transfer area for exchangers, or other appropriate cost unit for other types of equipment. Added are parallel and modular exchangers, valves, crucibles, thermowells and both armored and non-armored types of pipe and fittings.
Falls Industries, Inc., Aurora Rd., Solon, Ohio.

Drip-Proof Motors. Descriptive of the product's design features and explaining in detail how these multi-shielded motors can replace totally-enclosed motors in many applications where adverse conditions of moisture, humidity, dust, oil and chemicals prevail is four-page Bulletin 196.
Sterling Electric Motors, Inc., 5401 Telegraph Rd., Los Angeles 22, Calif.

Ammonia Valves and Refrigeration Products. Described in this 12-page catalog are semi-steel shut-off and expansion valves; bolted bonnet shut-off valves; ammonia flanged and check valves; all-steel gauge sets and needle point, line and purge valves; ammonia flanges; tee valves; three-way valves; relief valves and assemblies; 300-psi malleable iron fittings; 90 deg elbows and street elbows; 45 deg elbows; tees and crosses. Specifications, pipe sizes, product illustrations and descriptions are included.
Cyrus Shank Company, 4646 W. 12th Pl., Chicago 50, Ill.

Air-Cooled Condenser Catalog. Twelve-page Bulletin AC-102 presents an extensive analysis of these units from the standpoints of specifications and application. Four types of units are discussed in detail: those using propeller fans for horizontal air flow, propeller fans for vertical air flow, centrifugal fans for use with ductwork and centrifugal fans for residential air conditioning. Construction features are described, coil and fan data and capacities in Btu/hr at the evaporator are given in detail, and typical specifications are provided. Sections of the catalog are devoted to operation of air-cooled condensers under winter conditions, in indoor use and on residential and small commercial jobs.
Halstead & Mitchell, Bessemer Bldg., Pittsburgh 22, Pa.

Environmental Test Equipment. Duplicating global climatic conditions, equipment described in 44-page Catalog 560 includes large and small test cabinets, baths, ovens, steam-humidity chambers and bacteriological incubators. Numerous instruments for control of temperature and humidity are presented, with illustrations, applications and a temperature conversion chart.
American Instrument Company, Inc., 8030 Georgia Ave., Silver Spring, Md.

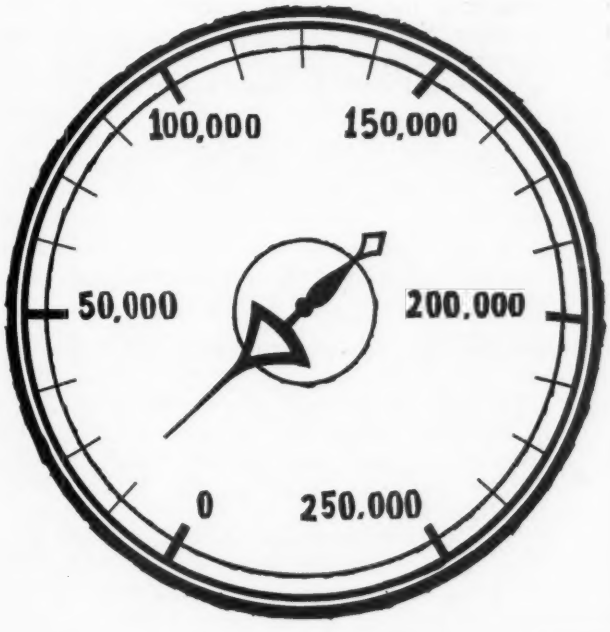
Straight Thread Ports. Covering benefits cited for these straight thread cylinder ports, Flyer S-113-1A also contains a table for determining proper port sizes for 1½ through 8-in. bore cylinders and explains the advantages of using straight thread ports in hydraulic cylinders.
Hannifin Company, Div of Parker-Hannifin Corporation, 501 S. Wolf Rd., Des Plaines, Ill.

Glass Fiber Tanks. For water softener applications, tanks presented in this bulletin are manufactured from glass mat and polyester resin, using a centrifugal molding process which provides void-free, uniform tank walls with high strength and light weight. Tanks are manufactured in four mod-

(*Continued on page* 82)

How about
getting up steam
on the
United Engineering Center campaign?





Announced in the October ASHRAE JOURNAL (page 54), the campaign to raise funds for our share of the new United Engineering Center in New York needs some prompt responses to be on schedule. Our goal is $250,000 in voluntary membership gifts to assure this new home for the American Society of Heating, Refrigerating and Air-Conditioning Engineers and 10 other national societies.

To date, our score is only a little over $16,500. from 350 or so contributors. As Chairman Merrill F. Blankin of ASHRAE has stated ". . . each individual subscription would be extremely modest if every member would do his share . . . Engineers must be counted on to give according to their abilities, which vary according to the rewards that engineering has afforded them."

For your convenience a contribution pledge form is incorporated within this page. Mail to ASHRAE, 62 Worth Street, New York 13, N. Y.

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What ASHRAE Regions and Chapters are doing

First technical sessions of the new year were held, with topics under discussion including heat pump applications, air pollution, dehumidifying, electric resistance heating and the patent system.

IOWA . . . Defining a patent as the right by law to exclude other people from using an invention for a period of 17 years, Patent Attorney George B. Newitt of Bair, Freeman & Molinare presented a talk on the "Patent System in American Business" at the January meeting.

Patents are non-renewable monopolies on a machine, composition of matter, article of manufacture, process, method or any improvement of these that is considered novel and useful. Purpose of the patent system, in the speaker's opinion, is to stimulate progress and new research, offering protection to the inventor. Attorney Newitt contends that the question "Has the patent system helped business?" is answered by American progress.

SOUTHERN CALIFORNIA . . . Tracing the characteristics of radial blade, forward curved and backward inclined blade blowers, speaker of the evening John R. Hall of Master Fan Corporation indicated how these characteristics show up on the Head vs Capacity curves, in his "Discussion on Fans." Covered in his talk were each of these three basic types of fan and their applications, together with a comparison of theoretical and actual Head vs Capacity curves.

NIAGARA FRONTIER . . . Presenting a talk on and demonstration of a Q-Air Floor, a product of their company, were J. Pierce and Glynn Rees of Robertson Irwin Ltd., speakers at the January 5th meeting. Advantages and application were discussed by Pierce, followed by an illustration of aerator operation under fluctuating load conditions by Rees, using a working model.

NORTH JERSEY . . . Four panelists discussed various aspects of "Commercial Electric Heating" at the January 7th meeting. Speaking were: C. W. Zimmer, "Electric Heat vs Wet Heat and the Fuel Situation"; David L. Thompson, Jersey Central Power & Light and New Jersey Power & Light Companies, "Economics of Construction for Buildings Designed for Electrical Heating"; David V. Boney, Atlantic City Electric Company, "Controls and their Application in Electrically Heated Buildings"; and John G. Snyder, American Electric Power Service Corporation, "Actual School Operation – Consumption and Cost Data."

CLEVELAND . . . Outlining the highlights of the three-pipe system and describing the York Hi-I Induction System, Fred Wood of York Corporation, speaker at the January 11th meeting, suggested a combined three-pipe and Hi-I system. Recent architectural design changes of curtain wall type construction and vastly increased use of glass have, he contends, presented new problems in perimeter heating and cooling. Use of a combined system such as he outlined would offer individual space control, increased flexibility, elimination of the need for temperature control change-over, reduced primary air requirements, and increased economy as compared with conventional induction systems or dual duct type velocity systems.

BRITISH COLUMBIA . . . Dividing his address into two parts, an outline of the basic principles of nuclear physics involved in the problem of nuclear power and Canada's nuclear power program, William Walker, Staff Engineer with British Columbia Electric Company, spoke on the "Canadian Approach to Economic Nuclear Power" at the January 13th meeting. Practicality of nuclear power is increasing, he stated, as available hydroelectric sites are being exploited, those remaining being in inaccessible locations and therefore costlier to utilize than erection of a nuclear plant. Slides showing the general design and layout, and component parts of nuclear plants illustrated his talk.

LOUISVILLE . . . Highlighting the January meeting was a guided tour through the Standard Gravure Plant of Louisville, prior to which Fred Schmidt, Chief Engineer of the Courier Journal and Times, explained the process of gravure printing and the

CHAPTER MEETING DATES

	Mar.	Apr.	May
Alamo	15	19	17
Arkansas	23	20	18
Atlanta	14	11	—
Austin	17	21	19
Baltimore	3	7	5
Baton Rouge	17	14	19
Boston	15	26	17
British Columbia	—	—	—
Central Arizona	—	—	—
Central Indiana	—	—	—
Central Michigan	8	12	10
Central New York	9	13	11
Central Oklahoma	14	11	9
Central Pennsylvania	—	13	—
Cincinnati	2	6	—
Cleveland	—	—	—
Columbus	21	18	16
Dallas	21	18	16
Dayton	2	6	—
El Paso	14	11	9
Evansville	1	5	3
Florida West Coast	16	19	17
Fort Worth	16	20	18
Golden Gate	3	7	5
Hampton Roads	—	—	—
Houston	18	15	20
Illinois	14	11	9
Illinois-Iowa	21	18	16
Inland Empire	9	12	10
Iowa	3	12	10
Jacksonville	1	1	3
Johnstown	8	12	10
Kansas City	7	4	2
La Ville de Quebec	14	11	9
Long Island	8	11	9
Louisville	14	11	9
Manitoba	24	28	—
Memphis	20	17	15
Michigan	21	18	24

necessity of close control of temperature and humidity. Following a movie on the subject, ASHRAE members and guests were shown through the plant, the air conditioning system of which has a capacity of 1120 ton.

CENTRAL ARIZONA . . . Placing emphasis on the inter-dependent roles of the scientist and engineer in present and future outer space explorations and developments, Patent Attorney Willard LeBlonde Groehne spoke on "From Earth to the Sun and Beyond" at the January 4th meeting. Illustrating his talk with slides depicting changes in environment from the lowest desert areas through jungle and temperate zones to the sparsely populated and vegetated areas of high mountains and then into outer space, he stressed the complex systems which must be developed to enable man to create a livable atmosphere and environment under these varying conditions.

NATIONAL CAPITAL & BALTIMORE . . . "American Industrial History" was the topic presented at a joint meeting of these two chapters, with J. Lewis Powell as the speaker. Pointing out how machines which are taken for granted have influenced our culture, he stated his contention that foremost among inventions in this country are the bicycle, sewing machine and reaper.

PITTSBURGH . . . Filtration of air will be considered as important, in the future, as filtration of water is today, Charles D. Wright of American Air Filter Company told members attending the January 18th meeting. He divided filters into three categories: viscous or impingement, dry or semi-dry and electro-static.

Stating that dry or semi-dry filters were introduced into the United States in 1880, viscous in 1921 and electro-static in 1937, the speaker covered filters available today, and described various methods of testing filter efficiency.

BOSTON . . . Two representatives of Carrier Corporation, H. E. Caswell and L. H. Leonard, discussed centrifugal and absorption refrigeration systems at the January meeting.

NEW YORK . . . In the construction industry, the successful completion of a job relies heavily upon close cooperation between the architect, consulting engineer, contractor and equipment manufacturer. The role of each has its responsibilities and must be coordinated with that of the others. In some instances these roles overlap or conflict; it is in such areas that much time is often spent working out problems.

Continuing its program of presenting, from time to time, a discussion between two or more of these individuals, this Chapter, at its January meeting, had as speakers Kent Attridge, Vice President of Welton Becket Associates, and John Anselmo of Sears & Kopf, who explored the relationship between architect and engineer.

CINCINNATI . . . Two speakers on the topic "Electrical Problems and Solutions on Air Conditioning Installations" were Robert D. Swanson of Cincinnati Gas & Electric Company and J. C. Latimer of General Electric Company. Speaker Swanson discussed electric distribution problems facing a utility company affected by voltage drop and inrush currents to heavy electrical equipment, while Latimer covered proper application of motors and motor controls in the range of 15 to 1000 hp.

CENTRAL NEW YORK . . . A two-fold program at the January meeting offered members an address by Charles A. Hathaway of Torrington Manufacturing Company, "Considerations in Air Impeller Design and Application," and a panel discussion on "Some Selection and Application Problems of Heating and Cooling Coils." Comprising the panel were Lewis A. Childs, Aerofin Corporation; Donald J. Girard, Trane Company; and Edgar L. Galson, Galson & Galson.

MONTREAL . . . Discussion group studies held during the 1958-1959 season on damage to coils (to date confined to damage from freezing) have led to preparation of an unofficial list of recommendations, D. J. McIntyre reported recently.

Involved are water in a confined space and air below 32 F. If water is permitted to remain in a tube long enough with air of this temperature surrounding it, it will freeze. How the freezing process takes place determines whether the tube will burst, bulge or show no outward sign that it has frozen other than the absence of heat radiation. With hot water coils, if the entering water temperature is high enough and the water is kept moving fast enough, it will not freeze. Steam condenses into water throughout the length of the heat transfer surface in steam coils. Here the problem resolves itself into

	Mar.	Apr.	May
Middle Tennessee	8	12	10
Minnesota	14	11	9
Mississippi	28	25	23
Mobile	—	—	—
Montreal	28	19	16
National Capital	1	5	—
Nebraska	8	12	10
New Mexico	15	19	17
New Orleans	15	19	17
New York	29	26	24
Niagara Frontier	7	7	2
North Alabama	—	—	—
North Jersey	3	7	5
North Piedmont	—	—	—
Northeastern New York	15	—	17
Northeastern Oklahoma	21	18	16
Northern Alberta	—	—	—
Northern Connecticut	10	14	12
Northern Ohio	—	—	—
Ontario	—	—	—
Oregon	17	14	12
Ottawa Valley	—	—	—
Panama & Canal Zone	8	12	10
Philadelphia	10	14	12
Pittsburgh	21	18	—
Puget Sound	—	—	—
Rhode Island	16	20	18
Richmond	7	4	2
Rochester	2	6	—
Rocky Mountain	2	8	—
Sacramento Valley	2	6	4
St. Louis	28	25	23
San Diego	8	12	10
San Joaquin	15	19	17
Savannah	15	19	17
Shreveport	17	21	19
South Carolina	21	18	16
South Florida	8	12	10
South Piedmont	—	—	—
Southern Alberta	—	—	—
Southern California	14	12	9
Southern Connecticut	8	12	10
Toledo	7	4	2
Tucson	—	—	—
Utah	18	15	21
West Texas	28	25	23
Western Massachusetts	17	21	16
Western Michigan	14	11	—
Wichita	15	19	17
Wisconsin	15	18	16

removal of this water from the coil quickly enough to prevent it from freezing. Recommended were various means of expediting water removal or circulation.

GOLDEN GATE . . . "Air Pollution and Control," with special reference to the problems in the Bay area, was the topic of Benjamin Linsky, Air Pollution Control Officer, guest speaker at the January 7th meeting.

OREGON . . . General application and use of cooling coils, both chilled water and direct expansion, has undergone considerable study in recent years. Problems have arisen in establishment of industry standards for rating and cataloging coils and the lack of practical installation data relating economy and efficiency, written specifically for the contractor. These and other highlights of this subject were covered by Walter P. Glancy and Michael Curtis of Aerofin Corporation, speakers at the January 14th meeting.

SOUTHERN CONNECTICUT . . . Water caused problems in air conditioning systems, an important consideration in the industry, were covered at the January meeting by Dr. Sidney Sussman, Chief Chemist of Water Service Laboratories, Inc.

NEW ORLEANS . . . Presenting in his address recorded data from a test heat pump installed and operated in his home for the past six years, Dr. Merl Baker of the University of Kentucky covered descriptions, definitions, application and essential factors for heat pump installations. Speaking at the January meeting, he introduced a new possibility for heat pumps, use as direct-fired heat generating sources for large applications.

WISCONSIN . . . Stating that before job performance can be up-graded, better installation practices must be applied, Arthur Pipe of York-Wagner was preliminary speaker at the January 18th meeting. If faulty operation results, he contends, the fault lies with the contractor who installed the equipment.

Following the business meeting, Glydewell Burdick of Wisconsin Power & Light Company spoke on "Electric Resistance Heating." With reference to residential electric heating, he stressed the importance of considering exposed surfaces of glass, thickness of insulation material and other such matters as well as air change. Equipment covered in his discussion included ceiling cable heaters, baseboard heaters, unit heaters and air handling equipment consisting of either in-space heaters or central furnaces. A question and discussion period followed.

MICHIGAN . . . As guests of the Central Heating and Sales Depts of Detroit Edison Company, members attending the January 18th meeting heard a panel discussion of "Coal to Comfort—District Steam Heating in Detroit," and were given the opportunity of touring the company's heating plant.

Comprising the panel, which described the system from arrival of coal on the dock to utilization of the steam by the customer's equipment, were Glen D. Winans, Leo F. Collins, Patrick R. Dwyer, Carl W. Signor and Carl B. Sprenger.

DALLAS . . . John A. McKay, Vice President in charge of the Industrial and Commercial Construction Materials Div of Owens-Corning Fiberglas Corporation, explored the "Role of the Mechanical Engineer in Upgrading Building Construction" at the January meeting.

SOUTH CAROLINA . . . Including in his talk a discussion on cost comparisons, David Rikleton, an engineer with Buensod-Stacey, spoke at the January meeting on "Application and Design of Dual Duct Air Conditioning Systems."

MOBILE . . . Serving as moderator for a discussion on "Packaged vs Central Station Air Conditioning Equipment," James Scott headed a panel comprised



Meeting before the evening program to attend to details and business to be brought before the full membership, officers, members of the Board of Governors and Committee Chairmen of the Atlanta Chapter are: (seated) Allen Gowdy, President; J. G. Woodroof, Regional Director; William Knox, Secretary; W. P. West, Vice President; James Edgar and James Latimer, Board of Governors; Jack Kelly, Treasurer; and (standing) Everett Gorbandt, Finance Committee; Robert Dean, Regional Delegate; Frank Carryl, Entertainment and Reception; Allan Livar, Special Events; Walter Garrard, Program; Randolph Edmundson, Publicity.

of Chapter members George Hamlin, Erwin Heblon, Kenneth Buck and Max Mutchnick, at the January meeting.

BATON ROUGE . . . Military Refrigeration was the topic presented by Welsh C. Whittlesey, formerly in charge of refrigeration work at the Quartermaster Research and Engineering Command of the U. S. Army, Natick, Mass., and speaker at the January meeting.

MINNESOTA . . . Viewing population growth as a dominant factor in construction industry activities, Edwin W. Magee, Jr., an Associate Economist for F. W. Dodge Corporation, spoke on "Sighting the Sixties and Beyond" at the January meeting.

Dr. Richard Jordan, Vice President of the Executive Committee of the International Institute of Refrigeration, has served in various engineering capacities throughout the world, traveling to Paris, London, Copenhagen, Karlsruhe and Munich in Germany, Moscow and Prague. Basing his February talk on information accumulated through his work, he spoke on "International Refrigeration."

COLUMBUS . . . Vibration, defined as a periodic motion of a body in alternately opposite directions from the position of equilibrium, when that equilibrium has been disturbed, is the cause of noises and may also be damaging to the environment. Describing new methods and materials for vibration isolation, Laurence L. Eberhart, President of Consolidated Kinetics Corporation, was main speaker at the January 18th meeting.

CENTRAL MICHIGAN . . . Concentrating his discussion on geographical limitations, heat sources and operation data, Dr. Merl Baker, Executive Director of the Kentucky Research Foundation of the University of Kentucky, spoke on "Application of the Heat Pump" at the January meeting.

KANSAS CITY . . . Russell W. Upham, Chief Engineer of the Air Conditioning and Refrigeration Sect of the Strategic Air Command at Offutt Air Force Base in Nebraska spoke on "SAC—its air conditioning problems both technical and political" at the January meeting. Illustrating his talk with slides, he discussed the basis of design for air conditioning systems and cold storage facilities.

SACRAMENTO VALLEY . . . Application of electrical motors to the air conditioning and refrigeration fields was discussed at the January 6th meeting by L. E. Long of Wagner Electric Corporation.

NATIONAL CAPITAL . . . Basing his talk on data accumulated in New York City over a period of ten years, Paul H. Kutschenreuter presented an analysis of "Weather and Mortality" at the February meeting. Data were presented within six categories, separated into divisions of lighter and darker-skinned persons. These categories were: seasonal basis, monthly basis, weekly basis, average week-day mortality, three-day average and departure of temperature of five deg above normal. Graphs showed a significantly higher mortality during summer than in winter, the major factor being departure from normal temperatures. No significant differences were indicated between the mortality rates of lighter and darker-skinned persons.

Contributing factors, in addition to temperature, are the humidity-temperature index, relative humidity and barometric pressure. Generally, there is a one-day lag between high mortality and extreme departure of normal temperature above 96 F. Air conditioning was cited as relieving these conditions and possibly serving to decrease the mortality rate from seasonal causes.

MONTREAL . . . Speaking at the January meeting on "Present Day Trends in Boiler Design," Gerald N. Martin, General Manager of the Boiler Div of Dominion Bridge Company Ltd., illustrated his talk with slides showing various boiler installations. Cited as influencing current trends were adaptability to use of a second fuel, availability of space, cost of material and cost of space and field erection. Other considerations include heating media (air, hot water, low or high pressure steam), location of the boiler room in the building and serviceability of the boiler. Problems associated with the use of different fuels – solids, liquids and gases – were discussed.

PANAMA & CANAL ZONE . . . Shown at the January 19th meeting was a film on air conditioning, prepared by York Div, Borg-Warner Corporation.

MISSISSIPPI . . . Use and operation of evaporator pressure and suction pressure regulator valves was the subject of an address presented at the January 25th meeting by Jack Franklin of Alco Valve Company.

SAN DIEGO . . . Stressing the importance of analyzing operating and owning costs of various facets of air conditioning systems, as well as initial costs, Dr. George E. Sutton of Arizona State University spoke on "Engineering Economics and Public Relations" at the January 12th meeting.

ONTARIO . . . Breaking down his talk into three parts: dehumidifying in the heat rejection cycle, equipment and applications, T. E. Gravenstreter of T. E. Gravenstreter & Associates, spoke at the January 4th meeting on "Dehumidifying—Equipment and Systems."

Members attending the February 1st meeting toured O'Keefe Centre, a new opera house constructed in Toronto. Guides explained the building's heating, ventilating and refrigeration equipment. Following the tour, the architect, Forsey Page of Page & Steele; consultant, Gerry Granek of G. Granek & Associates; and purchaser, Ross Service of O'Keefe Brewing Company, discussed the design and construction of the building from their various viewpoints. Murray Bowman of Spall-Bowman Company served as moderator.

Meetings ahead

March 6-10 – National Association of Frozen Food Packers, 19th Annual Meeting, Chicago, Ill.

March 21-23–First National Electric House Heating Exposition, National Electrical Manufacturers Association, Electric House Heating Equipment Sect, Chicago, Ill.

March 29-31 – American Power Conference, 22nd Annual Meeting, Chicago, Ill.

March 30 - April 1 – Gas Appliance Manufacturers Association, Annual Meeting, White Sulphur Springs, W. Va.

April 4-7 – Oil Heat Institute of America, Annual Convention, New York, N. Y.

April 4-7–Oil Heat Institute of America, 23rd National Oil Heat and Air Conditioning Exposition, New York, N. Y.

April 5-7 – Building Research Institute, Spring Conferences, New York, N. Y.

April 25-28 – National Association of Refrigerated Warehouses, Annual Convention, Bal Harbour, Fla.

April 27-30 – 3rd Western Air-Conditioning, Heating, Ventilating and Refrigeration Exhibit and Conference, Los Angeles, Calif.

May 19-21 – Refrigeration Research Foundation, Annual Meeting, Denver, Col.

May 22-25–Industrial Heating Equipment Association, Hot Springs, Va.

May 23-26–American Society of Mechanical Engineers, Design Engineering Conference, New York, N. Y.

May 23-26–Design Engineering Show, New York, N. Y.

June 6-9 – Institute of Boiler and Radiator Manufacturers, Annual Meeting, Absecon, N. J.

June 13-15–American Society of Heating, Refrigerating and Air-Conditioning Engineers, 67th Annual Meeting, Vancouver, B. C.

People

Russell C. Taylor succeeds **Richard H. Nelson** as Pacific Regional Manager of American Air Filter Company, making his headquarters in San Francisco. Vice President Nelson, relinquishing his responsibilities as Regional Manager, will continue as a Director of the company. Replacing Taylor as Manager of the Los Angeles branch office is **Charles J. Bressoud,** a sales engineer since 1954.

Hans Gold, appointed Chief Heating Engineer of the City of Toronto, Ontario, Can., includes in his responsibilities administration of the new Heating By-law applying to hot air, hot water and steam systems.



Roswell Farnham, with Buffalo Forge Company for 46 years, retired as Buffalo District Sales Manager on January 1st. A graduate of the University of Vermont, he is a Life Member of ASHRAE and a past-President of the Western New York Chapter of the former ASHAE. Past-President of the Engineering Society of Buffalo, he is a member and officer of the national, state and county Society of Professional Engineers.



Clarence E. Pullum, Executive Vice President, Treasurer and Director of Bell & Gossett Company, died January 8th after a long illness. Born in 1893, he was Chairman of the Board of Marble Companies, Gladstone, Mich., Director of the First National Bank of Morton Grove, Ill., past-President of Skokie Valley Industrial Association and a member of numerous other organizations. He joined Bell & Gossett in 1918, became Vice President in 1933 and Executive Vice President in 1954.

Pete J. Cummings, appointed Regional Service Manager for Fedders Corporation, will have his headquarters in Parkville, Mo., covering a region including Colorado, Missouri, Nebraska, Minnesota, North and South Dakota, Kansas, Iowa and a portion of Illinois. Prior to joining Fedders he was in charge of the Field Training Dept of Mathes Company, after 15 years in Chrysler Airtemp's field service dept.

William J. Morris, in his new position as Central Regional Manager for Acme Industries, Inc., will supervise sales activities in an eight-state area comprised of Illinois, Indiana, Iowa, Kansas, Missouri, Nebraska and North and South Dakota. His headquarters will be in Chicago, where he has served as application and sales engineer since leaving the U. S. Army Corps of Engineers in 1954.

Russell E. Comstock, who joined Copeland Refrigeration Corporation earlier this year as Manager of the southern central states district, has been named Chief Engineer, New Products. A graduate of Clarkston College of Technology, Potsdam, N. Y., he was formerly associated with Heat-X and Brunner Manufacturing Company.

Harry K. Ruyle, President of the Ruyle Refrigeration Company, was serving as Co-Chairman of the Program Committee of Illinois-Iowa Chapter at the time of his death recently. His activities in ASHRAE included a term on the Membership Committee.

B. F. Kubaugh, who passed away on December 25th at the age of 80, had been employed by Henry Vogt Machine Company for the last 63 years. At the time of his death he was Chief Engineer of the Tube-Ice Div. Holder of many patents on ice making and refrigerating equipment, he was a member of the National Association of Power Engineers and past-President of its Kentucky Chapter.

Frank K. Platt, Central Region Manager for American Air Filter Company, Inc., has been promoted to Assistant to the Manager of the School Air Systems Div, moving from Detroit to the company's home office in Louisville, Ky. With American Air Filter for 18 years, Mr. Platt will be responsible for nation-wide sales promotion in the educational and institutional building fields.

William F. Peters rejoins Anemostat Corporation in the capacity of General Sales Manager after serving as New York branch manager for American Air Filter Company. Prior to his association with the latter organization, Mr. Peters held various positions with Anemostat since first joining it in 1945 as a research engineer. He was appointed Eastern Regional Sales Manager in 1949 and Assistant General Sales Manager in 1956, leaving in 1958.

I. Ernest Shaer, deceased, was 61. A resident of the Boston area all his life, he operated his own heating and ventilating business.

Robert A. Wasson was elected President and General Manager of Clarage Fan Company at a recent meeting of the Board of Directors. With the company since 1922, he served in various sales and management positions before being appointed Assistant General Manager in 1944. In the following year he was elected to the Board of Directors and was elevated to Vice President and General Manager, a position in which he has served since that time. Active in the air moving industry, he was for two terms President of the National Association of Fan Manufacturers, served on the Board of Directors and several committees of the Air Moving and Conditioning Association and is a past-President of the New York Chapter of the former ASHAE.



Charles A. Hathaway, appointed Assistant General Manager of Air Impeller Div, Torrington Manufacturing Company, will have overall responsibility for all engineering, sales and production operations of the div. As Chief Engineer and then Director of Engineering for the past seven years, he supervised expansion of the engineering dept and development of air impeller testing facilities. After graduation from Massachusetts Institute of Technology, he served with General Electric Company, Perfex Corporation and Sharples Corporation, joining Torrington in 1950 as Laboratory Director. He was appointed Chief Engineer in 1953.



Gilbert T. Lord, a member of the firm of Hess, Greiner & Polland for 13 years, has been chosen to head the organization's new Northern California sales office. Assisting him, in the capacity of sales engineer, will be **Donald R. Dickson,** a graduate engineer with 11 years' experience in air conditioning.

R. E. Hall, named Midwest Region Commercial Sales Manager; **D. K. Ridley,** transferred to Philadelphia to direct contract operations in the industrial instrumentation field; and **Joseph Teskoski,** appointed successor to Hall as Branch Commercial Sales Manager in the Chicago office, are ASHRAE members assuming new positions with Minneapolis-Honeywell Regulator Company.

Gerald Gearon, Deputy Chief City Boiler Inspector of Chicago since 1919 and a city employe since 1910, died recently at the age of 69. A charter member and past Chairman of the National Board of Boiler and Pressure Inspectors of the United States and Canada, he helped draft the boiler code for the American Society of Mechanical Engineers.

George Brackett has been named application engineer of Kohlenberger Engineering Corporation, leaving his position as Chief Engineer and Assistant Manager of Lewis Refrigeration Company. Previously, he had been, for ten years, associated with Frick Company, Inc., in sales estimating and application engineering positions.

Gaetano DeFeo, an engineering graduate of Columbia University, is now a representative of Donovan Associates, a sales and engineering firm specializing in refrigeration, air conditioning and heating equipment. Here, he will be responsible for the southern Connecticut area. Most recently, Mr. DeFeo was associated with Carrier Corporation and several of its distributor organizations.

Others are saying——

that . . . . . dual duct systems, although initially expensive and, due to the extra reheat required, expensive to operate, provide excellent temperature control with many advantages over other systems. Reduced maintenance through central location of the air conditioning plant, no piping required outside the plant rooms, flexibility, individual room control of temperature and the fact that the system may be used in conjunction with an existing radiation system are among these advantages. *Refrigeration Journal, October 1959, p 17 (Australian).*

that . . . solution to problems presented in air conditioning a cited multi-storied apartment building were solved through use of a compensated central system. Installed in each living and bedroom is a fan-coil unit containing a coil for chilled or hot water, blower, filter and fresh air intake, with air discharge from the units deflected to cover the window areas and temperature regulated by master outdoor thermostats. Solar and wind compensating controls change the system from heating to cooling, allowing one zone to heat and the other to cool simultaneously, if required. Final space temperature in each room is controlled by a heating-cooling space thermostat which modulates a three-way water valve on the fan-coil unit. Fans operate continuously to provide make-up air to kitchens and bathrooms, all inside rooms. *Architectural Record, December 1959, p. 159.*

that . . . . . reliability, defined as "the probability that a device will perform, without failure, a specified function under given conditions for a specified period of time", takes into account such failures as are likely to occur in the object or system and causes of such failures. Since the reliability of a system is equal to the product of the separate reliabilities of its components, improvement of reliability of these individual parts would raise the level of reliability of the system as a whole. *Product Engineering, November 16, 1959, p 30.*

Candidates for ASHRAE Membership

Following is a list of 198 candidates for membership or advancement in membership grade. Members are requested to assume their full share of responsibility in the acceptance of these candidates for membership by advising the Executive Secretary on or before March 31, 1960 of any whose eligibility for membership is questioned. Unless such objection is made these candidates will be voted by the Board of Directors.

Note:
* Advancement † Reinstatement

REGION I

Massachusetts

BURTMAN, JACK, Engr.-Estimator, J. G. Lamotte & Son, Inc., Boston.
HOAGLAND, L. C., Chief Mech. Engr., Microtech Research Co., Cambridge.
KISHLER, M. I.,* Architect & Engrs. Repr., American Radiator & Standard Sanitary Corp., Boston.
MILLER, L. W., Sales Engr., Johnson Service Company, Springfield.

New Jersey

BAUTZ, R. R., JR., Repr., Slant/Fin Radiator Corp., Richmond Hill.
DUBIN, BERTRAM, Sales Engr., American-Standard, Newark.
HAMILTON, W. J., Sales Repr., Pacific Engineering Equipment Co., East Orange.
INZILLO, DANTE, Repr., Fleck Brothers Co., Camden.
LAIKIN, ALLAN, Estimator, Woodbury Coal & Supply Co. Inc., Woodbury.
LAMBERTA, DOMINIC, Repr., Minneapolis-Honeywell Regulator Co., Union.
MUSKA, EDWARD M., Chief Engr., Indoor Comfort Control Co., Perth Amboy.
SPAETH, H. W., Associate, Runyon & Carey Assoc., Newark.

New York

BECKER, EMIL, Sales Engr., Powers Regulator Co., New York.
BETANCOURT, M. J., Mgr. Htg. Div., Sales Engr., Public Fuel Service Inc., New York.
BONDAR, C. K., Installation & Appl. Engr., Htg. & A-C., Pioneer Air Conditioning Corp., Elmont.
BUCH, R. G., Detail Draftsman, Carrier Corp., Syracuse.
BUSCHELL, ALVIN, Gen. Sales Mgr., Slant/Fin Radiator Corp., Richmond Hill.
CHOW, JAMES, Sales & Appl. Engr., Borg-Warner International Corp., York Div., New York.
CORVINELLI, A. J., Proj. Mgr., Raisler Corp., New York.
DECKER, M. C., Engr., Carrier Corp., Syracuse.
GARDNER, J. P., Proj. Engr., Carrier Corp., Syracuse.
HOPKINSON, H. H., JR.,* Sr. Dvlpt. Engr., Carrier Corp., Syracuse.
JALBERT, D. M., Sales Engr., American Standard, Industrial Div., New York.
KILROY, T. F., Supvsg. Utilities Engr., American Hydrotherm Corp., Long Island City.
KLEINMAN, IRVING,* Cons. Engr., Massapequa.
LAMPEN, J. J., Purch. Engr., U N I-C E F/U N., New York.
MAYBECK, E. M., Design Engr., Donald M. Barnard, Rochester.
MEGNIN, J. G., Sales Engr., Powers Regulator Co., New York.
MOSES, MANFRED,* Partner, Abrams & Moses, New Rochelle.
ROACH, W. E., Tech. Repr., Worthington Corp., New York.
SAVETSKY, STANLEY, Designer, Voorhees Walker Smith Smith & Haines, New York.
SIEGEL, A. J., A-C Engr., W.O.R. Div., R.K.O. Teleradio, Inc., New York.
SPENCER, H. P., Contr. Sales Mgr., Power Regulator Co., New York.
WEITZ, HAROLD, Sr. Engr., Dept. of Correction, New York.
WRENCH, J. C., Dvlpt. Engr., Carrier Corp., Syracuse.
YORIO, J. A., Wholesale Mgr., R. J. Murray Co., Schenectady.
ZILKA, S. H.,† Voorhees Walker Smith Smith & Haines, New York.

Rhode Island

GATTO, J. R., Vice-Pres. & Gen. Mgr., National Plumbing & Heating Supply Corp., Providence.
MORGAN, W. T., Mfrs. Agent, William T. Morgan & Co., Providence.

Vermont

BROWN, J. W., Cons. Engr., Jennison Engineering Inc., Burlington.

REGION II

Canada

ANDERSON, H. V., Sales Engr., Electric Power Equipment, Ltd., Edmonton, Alta.
BERNHARDT, N. C., Territory Mgr., Lennox Industries (Canada) Ltd., Calgary, Alt.
BROUGHTON, F. W., Mech. Engr., Canadian National Railways, Toronto, Ont.
CREAN, K. R., Br. Mgr., American Standard Products (Canada) Ltd., Hamilton, Ont.
CUNLIFFE, J. A.,† Div. Mgr., Northwest Ceramics, Ltd., Edmonton, Alta.
DASHEVSKY, HYMEN, Cons. Engr., Toronto, Ont.
ENGLISH, S. F., Indus. Salesman, Dunham-Bush (Canada) Ltd., Toronto, Ont.
GARRAWAY, A. A., Repr., Canadian Ice Machine Co., Ltd., Edmonton, Alta.
HALL, B. R., Mech. Engr., H. K. Walter Assocs., Ltd., Hamilton, Ont.
HEPBURN, C. A., Service & Installation Supvsr., Honeywell Controls, Hamilton, Ont.
JOHNSTON, W. C., Com. Refr. Salesman, Bruce Robinson Electric (EDM) Ltd., Edmonton, Alta.
KING, H. M., Product Mgr., Trane Company of Canada, Toronto, Ont.
KRAKOW, K. I., Research in Gas Dynamics, National Research Council, Ottawa, Ont.
LANCZI, THOMAS, Vtg. & A-C. Designer-Draftsman, McDougall & Friedman, Montreal, Que.
LIDBETTER, K. W., Repr., Farr Co. Mfg. Ltd., Montreal, Que.
MCLEAN, A. A., Sheet Metal Supt., A. Clark Roofing & Sheet Metal, Edmonton, Alta.
MCMICHAEL, J. D., Chief Engr. & Vice-Pres., Norman A. Smith Co., Ltd., Leaside, Ont.
MCMULLEN, J. A., Mech. Supt., Morrison-Lamothe Bakery Ltd., Ottawa, Ont.
MEDD, R. R., Com. Refr. Salesman, Bruce Robinson Electric (EDM) Ltd., Edmonton, Alta.
O'CONNOR, BERNARD, Com. Sales Mgr., Bruce Robinson Electric (EDM) Ltd., Edmonton, Alta.
PADUCH, ROMAN, Estimator & Piping Designer, M. Emsig & Son, Ltd., Toronto, Ont.
PAUL, HENRY, Design Engr., McDougall & Friedman, Montreal, Que.
PROUDFOOT, R. G.,* Supvsg. Engr., Dept. of Public Works, Edmonton, Alta.
SEYMOUR, G. R., Commodity Mgr., Canadian Johns-Manville Co., Ltd., Port Credit, Ont.
SHIPLEY, P. M., Engr., Canadian Ice Machine Co., Toronto, Ont.
SINCLAIR, W. G., Sales Mgr., Sinclair Heating Supplies, Ltd., Edmonton, Alta.
YAKI, S. J., Sales Engr., Fleming Pedlar, Edmonton, Alta.

REGION III

District of Columbia

BURNETT, W. H., Br. Mgr., Armstrong Contracting & Supply, Washington.
ROBERTS, H. C., Design Engr., Karsunky, Weller & Gooch, Washington.

Maryland

BATTAGLI, S. S., JR., Asst. Mech Engr., U. S. Army, Army Chemical Center.
SIEGEL, R. H.,* Owner, Bayor & Siegel, Baltimore.
WHEELER, R. E.,† Chief A-C. Engr., Henry Adams, Inc., Baltimore.

Pennsylvania

BASH, C. G., JR., Sales Engr., George F. Bertrand Co., Philadelphia.

REEHM, H. E., Engrg. Supvsr., Delaware Valley York Inc., Philadelphia.
RICCIUTI, J. R., Mech. Designer, Food Fair, Philadelphia.
SCHMITZ, B. E.,* Sales Engr., Johnson Service Co., Pittsburgh.

Virginia

MONCRIEF, T. H., Engrg. Designer & Supvsr., Hankins & Anderson, Richmond.
THACKER, J. T., Sales Engr., Trane Co., Richmond.

REGION IV

Florida

GARRETT, L. L., Sales Mgr., Jones, Inc., St. Petersburg.
GRAHAM, H. G., Mfrs. Repr., Tampa.
KAISRLIK, D. L., Engr., Ebaugh & Goethe, Inc., Gainesville.
MOURE, E. P., Proj. Engr., Hill York Sales Corp., Miami.
PERRIN, WILLOUGHBY, Engrg. Designer, J. C. Pressly & Co., St. Petersburg.
WETHERINGTON, T. I., JR., A-C. Specialist, St. Petersburg.

Georgia

WALKER, H. F., Chief Engr., R. F. Knox Co., Inc., Atlanta.

North Carolina

CHRISTENBURY, B. L.,† Residential A-C. Engr., Duke Power Co., Charlotte.
JONES, M. A., Sales Repr., Trane Co., Greensboro.
LASHER, H. R., JR., Sales Engr., Powers Regulator Co., Greensboro.

REGION V

Indiana

RICHARDSON, JEROME, JR.,* Owner & Chief Engr., Jerome Richardson Assocs., Inc., Loogootee.

Ohio

FILLMORE, D. K., Sales Repr., Cooling Heating Distributing Corp., Toledo.
FRIEDLAND, ARMAND, Direct Factory Repr., Slant/Fin Radiator Corp., Cleveland.
GROSSER, L. C., Htg. & A-C. Engr., Beineke & Ruehlmann, Cincinnati.
HALL, T. M., Draftsman, Helmig-Lienesch & Assocs., Dayton.
PATTERSON, J. R., JR., Mgr. District Office, Trane Co., Dayton.
SYLVIA, F. J., Htg. & A-C. Engr., Ohio Fuel Gas Co., Columbus.

REGION VI

Illinois

FRITCH, E. L., Co-Owner, J. A. Fritch & Sons, Peoria.
WARREN, G. M., Sales Engr., Carrier Corp., Chicago.

Iowa

AVERILL, E. F., Chief Engr., Titus Manufacturing Corp., Waterloo.
JOHNSON, B. B., Asst. Research Engr., Titus Manufacturing Corp., Waterloo.

Michigan

BEZEMEK, JAMES, JR., Repr., Dunham-Bush, Inc., Grand Rapids.
BOYD, R. A., Indus. Project Repr., University of Michigan Research Institute, Ann Arbor.
FISCHER, D. H., Mech. Job Captain, Giffels & Rossetti, Detroit.
GHORAI, S. C., Graduate Teaching Asst., Michigan State University, East Lansing.
HALL, R. J., Sales Engr., Coon-De Visser Co., Detroit.
LOTTS, G. R., Mech. Engr., Eberle M. Smith Assoc. Inc., Farmington.
MALY, R. E., Sales Engr., Coon-De-Visser Co., Detroit.
MOUSSEAU, C. N., Appl. Engr., & Salesman, Bryant Manufacturing Co., Madison Hts.
OATMAN, G. S., Partner, Associated Heating Sales, Grand Rapids.
URBANOWICZ, H. R., Mech. Engr., Giffels & Rossetti, Detroit.
WITTER, C. E., Sales Engr., Coon-DeVisser Co., Detroit.

Wisconsin

ARCHIE, J. L., Sales Engr., Carrier Corp., Milwaukee.

REGION VII

Alabama

BROWN, JULIAN, Br. Sales Mgr., Carrier Corp., Birmingham.

Kentucky

ROSE, S. E., Prod. Design Engr., General Electric Co., Louisville.

Louisiana

FUNEL, JOHN, Engr., Equitable Equipment Co., Inc., New Orleans.
LOUDON, A. M., Field Engr., Square D Company, New Orleans.

Missouri

BURTON, L. E., Mgr. Residential Div., Heaven Engineering Co., Kansas City.
GRISBROOK, R. B.,* District Mgr., Tecumseh Products Co., Kirkwood.
HILL, G. H., Sr. Engr.-Design, Sverdrup & Parcel Engineering Co., St. Louis.
RINGER, J. A., Constr. Supvsr., Estimator, Industrial Heating & Plumbing Co., St. Joseph.
SHREWSBURY, J. B., Engr., Curtis Manufacturing Co., St. Louis.

Tennessee

DILLARD, W. E., Sales Engr., G. H. Avery Company, Memphis.

REGION VIII

Louisiana

GUTH, J. J., JR.,* Partner & Design Engr., Malahy & Guth, Shreveport.

Oklahoma

KOCH, EDWARD, Owner, Koch Engineering, Oklahoma City.
POCK, C. F., Asst. Mech. Engr., Coston-Frankfurt-Short, Inc., Oklahoma City.
WINTER, M. A., JR., Sales Engr. in Training, Johnson Service Company, Oklahoma City.

Texas

BARRETT, P. C., Owner, Phil Barrett Refrigerating Service. El Paso.
BURNS, R. E., Htg. Engr., Texas Power & Light Co., Dallas.
ENGBERG, N. W., Mgr., Dallas Operations Ref., Ansul Chemical Co., Fort Worth.
HANEY, G. M., JR., Mech. Engr., Haney Refrigeration Co., Galveston.
HOLT, G. V., Sales Engr., Minneapolis-Honeywell Regulator Co., Fort Worth.
MCMILLAN, H. D., JR.,* Owner, McMillan Equipment Co., Houston.
NAUGLE, J. C., JR., Chief Tech. Repr., Minneapolis - Honeywell Regulator Co., Houston.
WRIGHT, M. D.,* Pre-Sales Engr., York Corp., Houston.

REGION IX

Colorado

ANDERSON, W. R., Mech. Engr., Bureau of Reclamation, Denver Federal Center, Denver.

Nebraska

JONES, R. C., Sales Engr., R. S. Stover Co., Omaha.
SUNDBERG, P. L., Chief Mech. Engr., Consolidated Engineering Corp., Omaha.

REGION X

Arizona

MOODY, D. D., Engr., Baker & Moody, Cons. Engrs., Phoenix.

British Columbia

CLARKSON, E. C., Chief Constr. & Maint. Architect, Government of British Columbia, Victoria.
DREXEL, WILSON, Pres., F. Drexel Co., Ltd., Vancouver.
ELLINOR, J. G., Mgr. Refr. Dept., Fleck Bros., Ltd., Vancouver.
HAGGERTY, W. P., Vice-Pres. & Managing Dir., Lochhead - Haggerty Eng. & Mfg. Co., Ltd., North Burnaby.

California

BEVILLE, V. D., Assistant Prof. Mech. Engrg., Fresno State College, Fresno.
BYRNE, J. P.,† Systems Engr., AiResearch Mfg. Co., Los Angeles.
COX, E. V., Mech. Estimator, Whelan Mechanical Contractors, Sacramento.
DICKSON, D. R.,† Sales Engr., Hess Greiner & Polland, San Francisco.
HAGAN, D. D., Estimator, Western Asbestos Co., No. Sacramento.
KEOWN, D. E., Salesman, Estimator, C. S. Hardeman, Inc., San Francisco.
LAZARUS, LESLIE, Pres., Advanced Heating & Air Conditioning Co., Inc., North Hollywood.
MARTIN, JULIAN, Mech. Engr. & Vice-Pres., Tom A. de Vol Co., Stockton.
MITCHELL, R. W., Engr., Leonard S. Stecher, Cons. Engr., Sacramento.
MYTINGER, K. L., Mgr. A-C. Div., Gordon Service Co., Laguna Beach.
NEWMAN, T. E., Dist. Mgr., H. H. Robertson Co., San Francisco.
OMOTO, MITSUO, Draftsman, Leonard S. Stecher, Cons. Engr., Sacramento.
PREY, R. H., Vice-Pres., Advanced Heating & Air Conditioning Co., Inc., North Hollywood.
POWERS, W. P., Account Executive, Powers Regulator Co., Los Angeles.
PRIEST, R. G., Sales Engr., Master Fan Corp., Los Angeles.
WALLACE, J. E., Sales Engr., Johnson Service Co., Sacramento.
WILHOIT, J. W., Sales Repr., Minneapolis-Honeywell Regulator Co., Fresno.

Washington

DOHERTY, J. T., Owner, John T. Doherty & Assocs., Seattle.
TANEMURA, K. T., Research & Devlpt. Engr., Boeing Airplane Co., Seattle.
TURK, J. R., Secy.-Treas., McClintock & Turk, Inc., Spokane.
WELLS, J. H., Repr., Markel Electric Products, Inc., Everett.

Alaska

DUNEFORD, R. G., Design of Plbg., Htg. & Refrg., Paul B. Crews & Assocs., Anchorage.
LEWIS, C. R., Pres. & Gen. Mgr., C. R. Lewis Co., Inc., Anchorage.

Canal Zone

BAILEY, M. K., Engineman, Lead Foreman, Panama Canal Co., Refrigeration Plant, Mt. Hope.

Philippines

ABAD, V. S., Chief Engr., Engineering Equipment & Supply Co., Manila.

FOREIGN

Australia

ANDERSON, THOMAS, Cons. Engr., Thomas Anderson & Assocs., Melbourne.

Guatemala

BARILLAS, JORGE, Gen. Mgr., J. G. Alvarenga, Guatemala City.

Italy

ANSELMI, UGO, Tech. Mgr., Carlo Ferrari Co., Torino.
PALMIZI, FRANCO, Cons. Engr., Milano.

New South Wales

DEWHURST, I. S., Tech. Service Officer, Design, Australian Sisalkraft Co., Pty. Ltd., Homebush.

New Zealand

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NUNES, M. D., Engr., General Electric Portuguesa, Lisbon.

Scotland

KOTUBI, A. R., Refrigeration Practice Work, L. Sterne & Co., Ltd., Glasgow.

Singapore

KOON, L. C., Appl. & Design Engr., International Air Conditioning Co., Ltd.

South America

MORALES, RAFAEL, Chief Engr., Indufrial Ltda., Colombia.
BROMET, R. J., Tech. Director, H. Bromet, Suriname.

Switzerland

WAECHTER, HANS, Mgr., K. Waechter, Htg. Engr., Zurick.

Venezuela

LOWENTHAL, ERIC, Cons. Engr., Caracas.

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FUJITANI, H. A., Calif. State Polytechnic College, San Luis Obispo, Calif.
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JONES, G. A., Calif. State Polytechnic College, San Luis Obispo, Calif.
KING, L. W., Calif. State Polytechnic College, San Luis Obispo, Calif.
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STEIN, MANFRED, Calif. State Polytechnic College, San Luis Obispo, Calif.
VEIT, R. W., Calif. State Polytechnic College, San Luis Obispo, Calif.
WASHINGTON, J. T., Calif. State Polytechnic College, San Luis Obispo, Calif.
WOMER, W. H., Calif. State Polytechnic College, San Luis Obispo, Calif.
ZIMMERMAN, K. T., Calif. State Polytechnic College, San Luis Obispo, Calif.

GATENBY HEADS ASHRAE JOURNAL SPACE SALES



William J. Gatenby, formerly Midwest Advertising Representative of the ASHRAE JOURNAL, is now Advertising Sales Manager. He continues to make his headquarters in Chicago. The ASHRAE advertising office is at 62 Worth Street, New York 13, N. Y. Mr. Gatenby, who prior to his association with ASHRAE was Midwest Sales Representative for Railway Age and before that Sales Manager of the Capex Company, succeeds R. T. Biedler as Advertising Sales Manager of the ASHRAE JOURNAL.

BULLETINS

(*Continued from page 72*)

els, each with a different configuration and fitting arrangement. All models are available in either 7 or 9½-in. diam, with three capacity options for each diam and model.
Apex Reinforced Plastics Div, White Sewing Machine Corporation, Washington & Elm Sts., Cleveland 13, Ohio.

Isolators. Series 260 and 297 isolators are the subjects of Flyer 59-04.4, which presents curves showing variation of vertical natural frequency with various loads for each model. Standard installation practice is to support the mounted equipment on single isolators or tandem pairs placed under the mounting feet; shock, vibration and noise caused by rotating, impact and reciprocating machines are cited as being reduced.
Barry Controls, Inc., 700 Pleasant St., Watertown 72, Mass.

Environmental Test Equipment. Thirteen different types of equipment are described and illustrated in Flyer C-14, which features an acoustic-noise test system, auxiliary vibration tables and saw-tooth shock machines, as well as this manufacturer's line of environmental test chambers.
Associated Testing Laboratories, Inc., 401 Clinton Rd., Caldwell, N. J.

Electronic Signal. Signalling at the first sign of refrigerant leak or any



New Century Electric motor provides low-cost power for fans, blowers, pumps and compressors.

New Century Electric part-winding motor gives extra smooth start

This new motor . . . at either 1200 or 1800 rpm's . . . will give smooth, cushion acceleration. No cogging, jerking or jarring equipment. Just dependable starting power with the same reduction in starting current of all Century Electric part-winding motors. A special winding scheme makes this extra smooth start possible.

Applications—Have an application where power company restrictions limit inrush current? The complete line of Century Electric part-winding start motors may be the answer. They provide the most economical and dependable way of starting equipment such as fans, blowers, centrifugal pumps and compressors, as well as reciprocating compressors with unloading valves.

Reliable power—High quality construction features include . . . coils insulated with tough polyvinyl acetal resin . . . windings dipped and baked with several coats of high temperature synthetic varnish which protect against oil fumes, mild acids, dust and grit . . . rotors dynamically balanced so motors run smoothly and quietly . . . rugged cast iron frame for long life and low noise level. Century part-winding start motors are available in 20 to 150 hp sizes and in speeds of 1200 and 1800 rpm.

Application aid—A Century Electric application engineer will be glad to discuss your part-winding start problems with you. Century Electric also makes a complete line of motors . . . all sizes and types from 1/20 to 400 hp. For a copy of the new Century Electric Motor Application Guide, please write for bulletin 270A. For *more* than a motor . . .

CENTURY ELECTRIC COMPANY

St. Louis 3, Missouri *Offices and Stock Points in Principal Cities*

Century

59-13

malfunction causing gas bubbles to appear in the liquid line, the Electronic Sentry also detects and signals the occurrence of any condition that might result in non-operation of the compressor while the thermostat or compressor motor control device is calling for refrigeration. Flyer No. 12 is descriptive of the instrument.
Televance Corporation, St. Louis 23, Missouri.

Low Temperature Brazing Alloys. Listing compositions, melting points and other data about the company's line of silver solder, low fuming bronze, nickel-silver and other available brazing alloys, this four-page bulletin also contains a chart comparing the composition of the line of phosphorus-copper-silver alloys with that of other manufacturers.
American Brazing Alloys Company, P. O. Box 11, Pelham, N. Y.

V-Belt Drives. Thirty-six pages of information on a drive cited as reducing overall drive dimensions by as much as 50% and saving as much as 25% in weight and 30% in cost as compared to conventional V-belt drives, are provided by Bulletin 9102. Comprising this information are: drive selection tables for stock and non-stock sheaves, hp tables, nomograms for service-level comparisons of drive costs, sheave and belt specifications, bushing and keyseat specifications, installation instructions for "Sure-Grip" sheaves and information on how to check the tension of Ultra-V drives.
T. B. Wood's Sons Company, Chambersburg, Pa.

Unit Air Filters. Descriptive of construction and application of permanent washable unit air filters, 12-page Bulletin 207 illustrates and explains advantages of Types HV-2, high capacity, low resistance unit; M/W, heavy-duty metal filter; AL-2, aluminum filter; S, spray booth filter; and special air filters such as used in radar, electronic cabinet ventilation, airplane engine intake and submarine services. Included are explanations of filter maintenance methods and the equipment necessary, installation data, charts, arrestance-resistance curves, engineering data and dimension drawings.
American Air Filter Company, Inc., 215 Central Ave., Louisville 8, Ky.

Industrial Heating. Cited as containing all information necessary for design of industrial heating jobs using direct fired heaters (with heat exchangers), this 64-page application manual covers definitions of terms, extensive explanations of direct-fired heaters, heat loss calculations, air distribution (nozzle and duct), single and multiple installations, door heating, process heating, make-up air, fuel piping design and consumption and controls. Conversion tables for pressure, temperature, weights and measures are included.
Lennox Industries, Inc., 200 S. 12th Ave., Marshalltown, Iowa.

Ceiling Diffuser Damper. Features of the damper described in Flyer 262-AC include knob operator for opening or closing damper, which also locks it in any position; rack and pinion gear operation of butterfly valves without linkage, chains or springs; and high velocity performance. Square and round models are illustrated.
Air Control Products, Inc., Coopersville, Mich.

Air Conditioning Products. Introducing an extensive line of high-pressure air handling units, ranging from zero to eight-in. static pressure, this catalog also details a new air handling line for complete humidity control, initially offered in nine sizes. Rounding out the bulletin are the regular

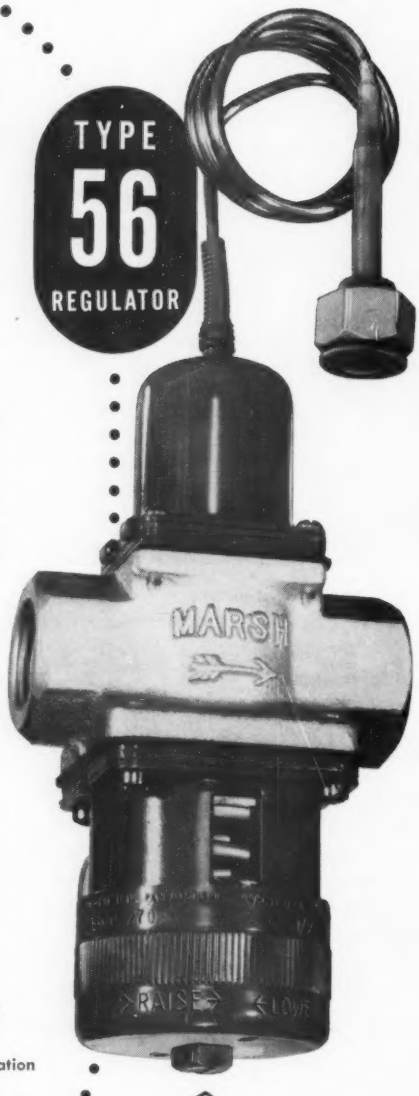
THE MOST! — in every department

That's the verdict of men who know water valves.

They like its wide range: One valve adjustable for both R-12 and R-22 without changing springs. Simply turn the knurled cap to any setting from 60 to 270 lbs. Cap can be easily removed and the setting made tamper proof when desirable.

They like the way it fits in: Small and compact, but with ample capacity, smooth modulation, excellent flow characteristics.

They like its quality construction: Monel seat beads that minimize wire drawing; direct acting leak proof bellows. They like the provision for manual flushing after installation to remove dirt and grit. Bulletin tells the story.



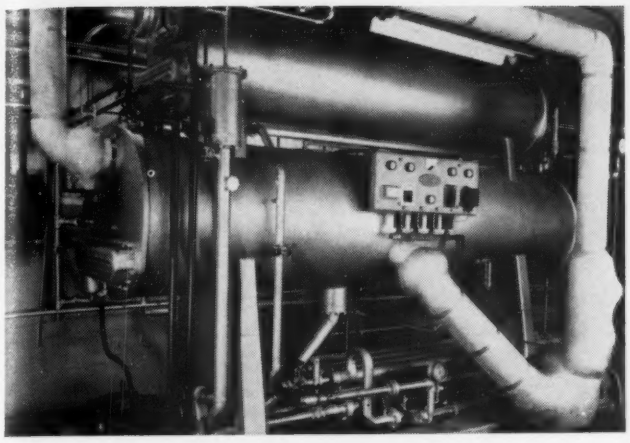
Nut provides for tamper proof setting when this is desirable.

Buy it from your wholesaler

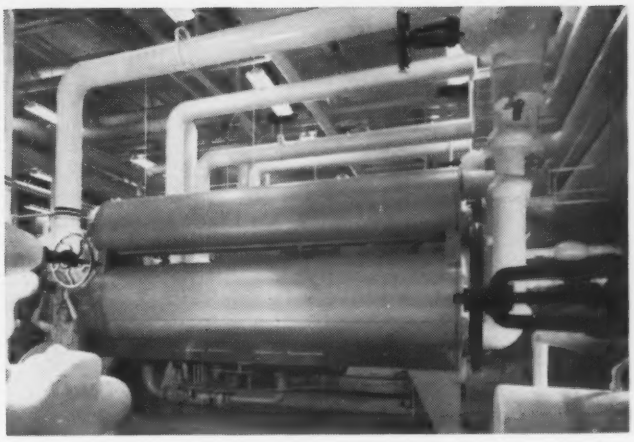
MARSH INSTRUMENT COMPANY
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Marsh Instrument and Valve Co. (Canada) Ltd., 8407 103rd St., Edmonton, Alberta
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FOURTEEN YEARS AGO, the first Carrier Absorption Refrigeration Machine was installed in the Sealright Corporation's plant in Fulton, New York. This pioneer machine has been in continuous operation ever since.



TODAY, here's one of more than 1500 Carrier Absorption Refrigeration Machines in operation around the world. Today's modern Carrier automatic models cover a wide range of capacities from 50 through 1000 tons.

4 FACTS

TO REMEMBER WHEN YOU SPECIFY ABSORPTION REFRIGERATION

1 Carrier is years ahead of any other manufacturer in this specialized field. Carrier designed and built its first Absorption Refrigeration Machine fourteen years ago. This pioneer machine is delivering efficient, dependable service around the clock.

2 Today more than 1500 Carrier Absorption Refrigeration Machines are serving factories, office buildings, hospitals, hotels, schools, universities and other structures around the world. They have established an unmatched record for economy of operation.

3 Since the first machine, Carrier has effected many advances in design in its models. Today's Carrier Automatic Absorption Refrigeration Machines deliver the last word in efficient, reliable, low-cost cooling from low-pressure steam or hot water.

4 Carrier's long background of experience on every type of application is at your disposal. Qualified representatives are ready to work with you on your projects. Write Carrier Corporation, Syracuse 1, N. Y. In Canada: Carrier Engineering Ltd., Toronto.

BETTER AIR CONDITIONING FOR EVERYBODY EVERYWHERE

Carrier

lines of Perma-Fan evaporative condensers, from 5 to 110 ton; room-by-room air conditioners for remote or ceiling suspension; Flexazone air conditioners for independent/variable year-round temperature control; single-zoned HSV and CSV Series air handlers; and air-cooled condensers.
Drayer-Hanson Div, National-U. S. Radiator Corporation, 3301 Medford St., Los Angeles 63, Calif.

Stainless Steel Tubing. Details on the various sizes, grades, design data, corrosion resistance and other information pertaining to welded and seamless stainless steel tubing are provided by 36-page Bulletin SS39-Ed 1. More than 25 tables on stainless steel tubing, and a special section on composite tubing are included.
Allegheny Ludlum Steel Corporation, Oliver Bldg., Pittsburgh 22, Pa.

Flexible Connectors. Developed for use on pump installations, hot water systems and steam systems where thermal expansion and vibration are problems, Penflex Flexible Connectors are the subject of a flyer. Cited as being of special interest to those in industries utilizing pumps to move hot materials, as well as in the air conditioning and refrigeration industries, the catalog sheet details construction and available sizes and presents product illustrations.
Pennsylvania Flexible Metallic Tubing Company, 7200 Powers Lane, Philadelphia, Pa.

Grilles. Covering models, ordering instructions, application data, selection procedure and performance data on these Customline Grilles is 8-page Bulletin E500.
General Air Products Corporation, 14 Factory St., Cedar Grove, N. J.

Sliding Gate Seats. Low flow sliding gate seats are now available for regulators and control valves for ¼ through 3-in. sizes. Stainless steel with industrial hard chrome finish, seats are self-lapping and self-cleaning in operation and give tight shut-off. Descriptive of them is 4-page Bulletin J-DI, which also discusses self-contained pressure reducing valves and self-operated temperature control valves.
OPW-Jordan, 6013 Wiehe Rd., Cincinnati 13, Ohio.

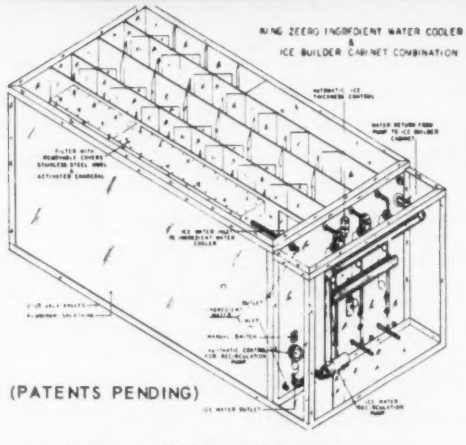
Valve Attenuator. Pneumatically activated, the Series 45P uses no motors or linkage mechanism of any kind, and is designed especially for use in dual duct, constant volume high velocity air distribution systems. Four-page Bulletin K-45 lists the unit's features, explains its function (assisted by a diagram) and provides complete performance data. Also given are dimensions, specifications and a reference list of users of this equipment.
Connor Engineering Corporation, Danbury, Conn.

Parts and Supplies. Equipment for the refrigeration and air conditioning industries is the subject of a 240-page catalog, the 1960 Spring Edition of this company's Dependabook. General information on such subjects as compressor wiring terminals and starting relay coding is also contained.
Harry Alter Company, 1717 S. Wabash Ave., Chicago 16, Ill.

Leaks in Vacuum Systems. Four-page Bulletin GET-2935 provides detailed information on how to use halogen-sensitive vacuum leak detectors in the laboratory and in production to locate leaks down to 1×10^{-6} cc/sec. Typical applications include vacuum furnaces and metalizers, production testing of refrigeration units before

(*Continued on page* 90)

For Ideal Filtered Ingredient Water at Low Cost



(PATENTS PENDING)

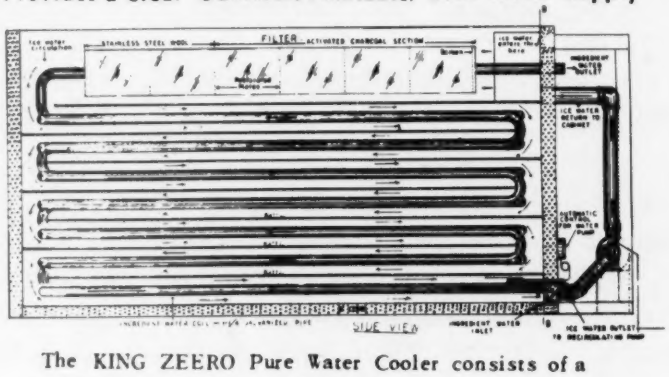
- Cools water 34 degrees Fahrenheit.
- Filter removes all silt, algae and chlorine from city or well water supply.
- Pure water is chilled by ice water -- *prevents freeze-ups.*
- The ideal water for ingredient and wash water applications -- food processing needs, butter or cheese wash, dough water, poultry or produce chilling.

Available in Cabinet or Vertical Styles.

Write for Bulletin PWC 59.

Choose "King Zeero's" NEW PURE WATER COOLER

Provides a Clear Odorless, Palatable, Cold Water Supply



The KING ZEERO Pure Water Cooler consists of a galvanized pipe water coil, a self contained efficient charcoal filter, a KING ZEERO Ice Builder and an ice water recirculation pump, with controls and necessary valves for flow and back wash, all contained in an integral unit.

THE KING ZEERO COMPANY 4300-14 W. Montrose Ave. Chicago 41, Ill.

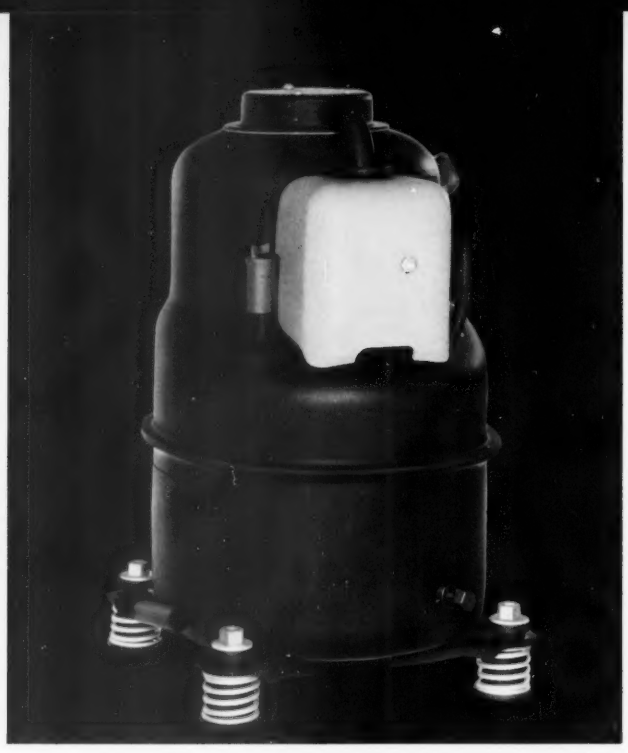
Manufacturers of Ice Builders - Ice Builder Cabinets - Ice Banks Pure Water Coolers



BLUE RIBBON QUALITY... AWARD WINNING PERFORMANCE

One of the most valuable features you can give your air conditioning or refrigeration equipment is a compressor that really performs under pressure. And when you install Bendix-Westinghouse, you're installing the best. No other can match them for dependability and downright quality. Turn the page and read all about the new Bendix-Westinghouse compressor that can help you cut production costs on heat pumps and air conditioning units.

Bendix-Westinghouse MOTOR COMPRESSORS



MANUFACTURERS: YOU'LL FIND NEW BENDIX-WESTINGHOUSE COMPRESSORS LOWEST IN COST, HIGHEST IN EFFICIENCY!



There's no better way of cutting production costs than including this new Bendix-Westinghouse YH1020TA 4-h.p. compressor in your blueprints for heat pump and air conditioning units.

Due to its two-pole design, it is compact in size, so takes less installation space. Lighter in weight . . . so saves on shipping costs. Lower in price . . . so saves on your production costs.

Like all Bendix-Westinghouse compressors, this brand-new model utilizes full gas suction cooling and positive pressure lubrication. Maximum performance in every operating range is assured by an inherent overload protection system. Motor insulation is of the latest and best type.

All this adds up to a longer life expectancy with trouble-free performance and ready customer acceptance. Call or write direct for prices and detailed specifications.

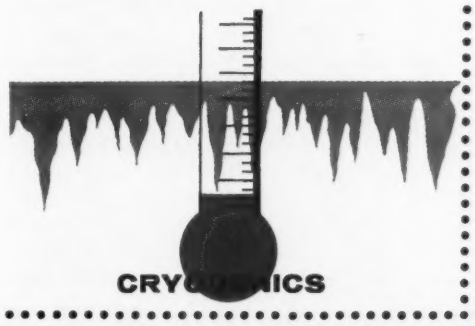
Bendix-Westinghouse

EVANSVILLE, INDIANA

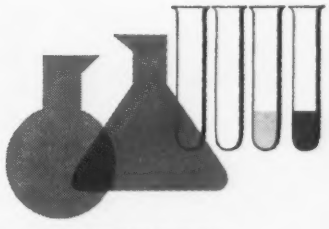
A Division of Bendix-Westinghouse Automotive Air Brake Company, Elyria, Ohio
Export Sales: Bendix International, 205 E. 42nd St., New York 17, N. Y.

UNION CARBIDE announces a new personalized assistance program for air conditioning and refrigeration equipment manufacturers. Through your UCON Brand Refrigerants representative, CARBIDE offers you the experience of hundreds of specialists in cryogenics, metallurgy, chemistry and materials research.

Can CARBIDE technology help you find better lubricants? Help you solve special corrosion problems? Assist you in developing plastics and elastomers? See your UCON Refrigerants representative ... and find out how this new personalized assistance program can work for YOU!



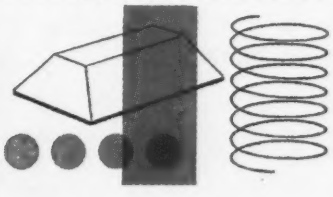
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MATERIALS RESEARCH

A new 96,000 square foot laboratory at Tarrytown, N. Y. will be an important part of CARBIDE's new assistance program. In this building, scientists and technicians from all areas of Union Carbide Chemicals Company's wide-ranging activities will pool their research experience to help you find practical answers to your problems. Your UCON Refrigerants representative makes this concentrated experience available to you, through CARBIDE's personalized assistance service. See him, soon! Call, write or wire UCON Refrigerants, Union Carbide Chemicals Company, 30 East 42nd Street, New York 17, N. Y.

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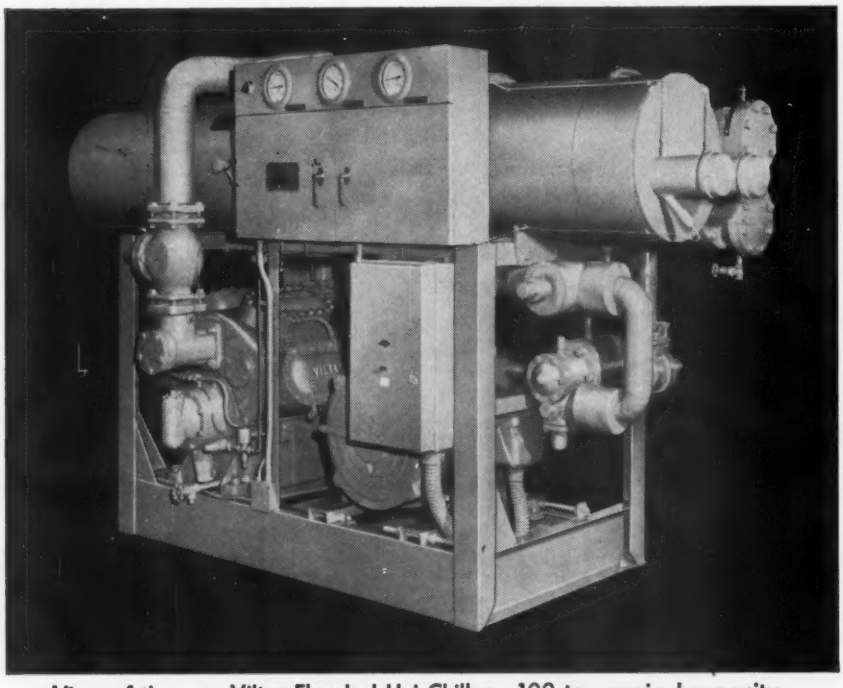
These 5 UCON Brand Refrigerants will meet your refrigeration and air conditioning needs

UCON Refrigerant 11 Trichloromonofluoromethane
UCON Refrigerant 12 Dichlorodifluoromethane
UCON Refrigerant 22 Monochlorodifluoromethane
UCON Refrigerant 113 Trichlorotrifluoroethane
UCON Refrigerant 114 Dichlorotetrafluoroethane

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UNION CARBIDE CHEMICALS COMPANY *Division of Union Carbide Corporation*
30 East 42nd Street • New York 17, New York

Air-conditioning made easy with new space-saving fully flooded Vilter Chiller



View of the new Vilter Flooded Uni-Chiller—100-ton nominal capacity.

Compact, space-saving design, low cost and a flooded water chiller are some of the important advantages of the new Vilter flooded type Uni-Chiller.

While especially suited for air conditioning applications, Uni-Chillers fit readily into almost any liquid chilling system.

Four standard sizes are offered—25, 50, 75 and 100-ton nominal capacities.

All components are sized to operate efficiently as a system. The flooded-type shell and tube cooler and the condenser are mounted above a rugged Vilter VMC compressor. Shipped assembled, the Uni-Chiller arrives with all interconnecting piping completed, controls factory wired, cooler and low-temperature piping insulated and a holding charge of refrigerant.

Motor and starter can also be supplied by Vilter and if desired, the compressor and motor can be run-in and all controls and gauges properly adjusted and set. By specifying a completely assembled unit, installation costs and start-up time are reduced . . . real savings to you.

Why not contact your nearest Vilter representative or write directly to Vilter for full details and application recommendations.

Vilter® refrigeration air conditioning

The Vilter Manufacturing Company
Milwaukee 7, Wisconsin

Air Units • Ammonia and Freon Compressors • Booster Compressors Baudelot Coolers • Water and Brine Coolers • Blast Freezers Evaporative and Shell and Tube Condensers • Pipe Coils Valves and Fittings • Pakice and Polarflake Ice machines.

We will be pleased to send you complete details on the above equipment.

Write Vilter Dept. AR-913

BULLETINS

(*Continued from page 86*)

charging with refrigerant and for any other evacuated enclosures where vacuum is one to 500 micron or more. Included are description of the Type H-4 leak detector, installation and operation procedures, and techniques for locating leaks.
General Electric Company, Schenectady 5, N. Y.

Evaporative Water Coolers. One-source engineering data, unit selection charts and selection tables for this line of blow-through type equipment are given in eight-page Bulletin PFCF 531.08. Detailed are external/internal construction features, carried under such headings as Housing, Coils, Spray Section, Motor-Pump Unit, Fan Section, Legs and Finish. Dimensional drawings key to a Table of Dimensions for the 13 charted models in the line, capacities of which range from 5 to 110 ton.
Drayer-Hanson Div, National-U. S. Radiator Corporation, 3301 Medford St., Los Angeles 63, Calif.

Process Heating Problems. Useful in the solution of process heating problems, four-page Bulletin 102.2 describes how liquid heat transfer units for heating jacketed equipment of all types can be used to advantage in the process industries. Illustrated examples of engineered application of packaged heating units are provided, with diagrams and specifications of this manufacturer's heating equipment.
Hynes Electric Heating Company, P. O. Box 1004, Mountainside, N. J.

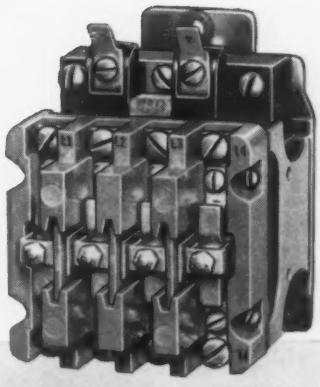
Plastics Compounds. Used for the production of reinforced plastics ducting mandrels, filament winding mandrels and pressure vessels with breakaway and washaway type molds, a line of hot-melt, water soluble compounds, designated Paraplast, is the subject of four-page Bulletin RPD-1000. Features claimed for these compounds include: when liquidized can be cast to final shape without the use of parting agents; when solidified have a compressive strength as high as 19,000 psi at temperatures up to 475 F; cast shape will retain dimensional accuracy from room temperature up to 475 F; and molds or mandrels can be dissolved in water or remelted and material reused.
Rezolin, Inc., 1651 18th St., Santa Monica, Calif.

E
ESSEX ENGINEERED
E

This Complete RBM Control Family

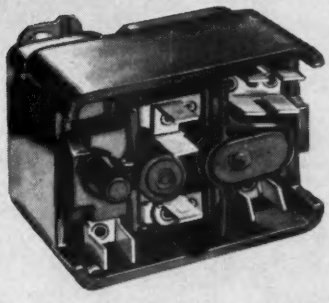
is specially engineered for the air conditioning industry

When RBM specially engineered its first air conditioning control, it quickly recognized the industry need for not just one . . . but for a *complete family*. So RBM has done the job. Now there is a single source for *all* magnetic air conditioning controls . . . each one meticulously engineered for its application. What's *your* requirement? See RBM.

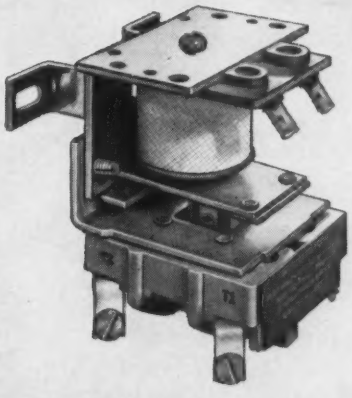


TYPE C—30, 40, 50 AMP. 2-3-4 pole 30 amp.—600 volts. 2-3-4 pole 40 amp.—230 volts. 2 pole 50 amp.—230 volts. Same mounting holes and coils for all ratings and pole forms.

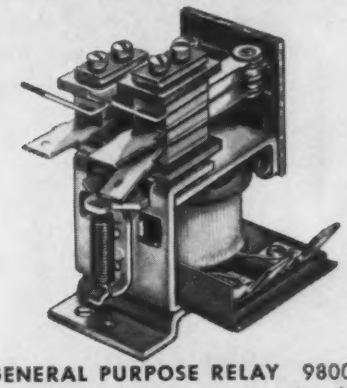
ALL PRICED TO MEET THE NEEDS OF VOLUME USERS



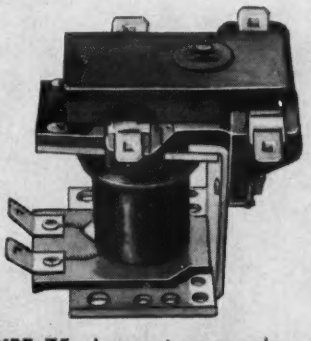
SERIES 128000 POTENTIAL STARTING RELAYS For starting single phase capacitor start compressors.



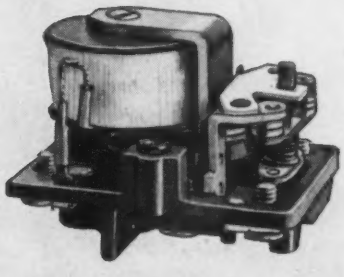
TYPE 80 CONTROLLER Specific design for nominal 3 HP or 3-ton single phase compressors.



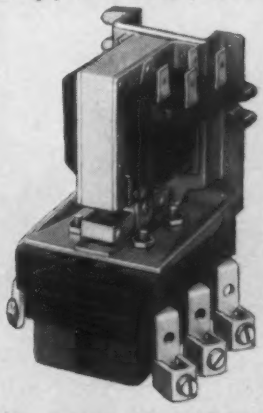
GENERAL PURPOSE RELAY 98000 Series AC or DC. Permits engineering short cuts lowering your "finished product" cost.



TYPE 75 Low cost power relay. Dependably handles up to 6000 W. at 240 V., resistive load per pole. Compressor rating 2 poles, 18 amp. running, 90 amp. locked rotor at 250 volts.



SERIES 129000 SHUNT TYPE RELAY—SPNO, SPNC or NO-NC For standard commercial voltages. Other coils available for special application. For heater, fan control, general circuit switching, etc.



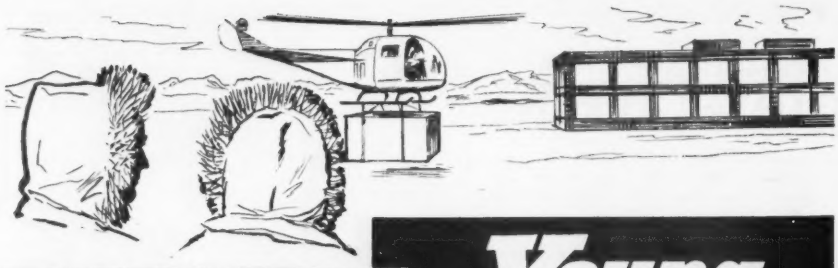
TYPE S—30—40 AMP. Low cost. Small size. Exceed rigid requirements of industry's largest users.

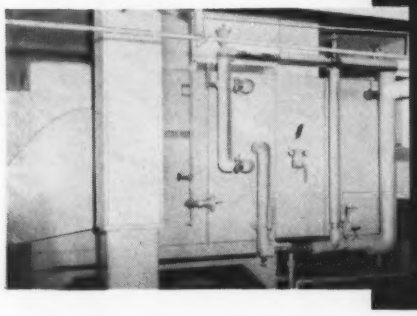
Consult your local RBM Product Application Engineer or Write for Bulletins 1030A, C-8, 1010A, 1060 and C-10.

RBM **RBM Controls Division**

ESSEX WIRE CORPORATION, LOGANSPORT, INDIANA

Factories Located at North Manchester and Logansport, Indiana



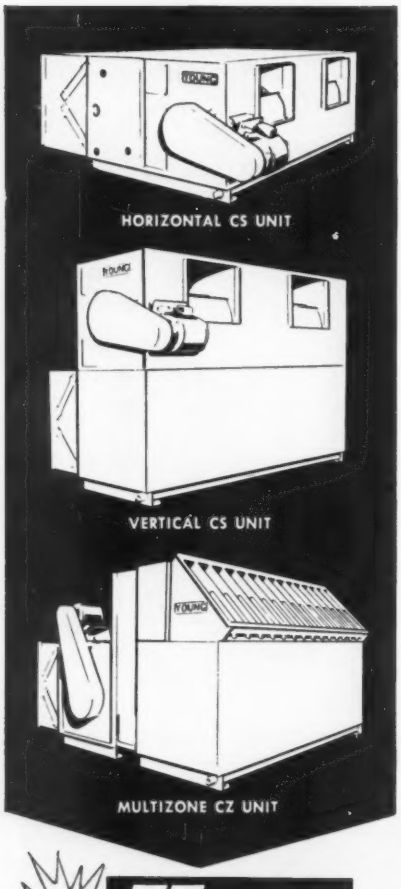


Young

CENTRAL STATION AIR CONDITIONING UNITS PROVIDE IDEAL CLIMATE IN "NATURE'S ICEBOX"

YEAR around comfort is assured personnel at the Administration building, Elmendorf Air Force Base near Anchorage, Alaska.

Seven Young "CS" Units completely condition the air during all seasons . . . dehumidifying and circulating cool air during the short but warm Alaskan summers, and providing heated humidified air during the long extremely cold winter months.



COMPLETE FLEXIBILITY

Young Central Station Air Conditioning Units are manufactured in ten sizes, with a range of air volume capacity from 700 cfm to 28,000 cfm in Vertical or Horizontal types. Multizone units are available in nine sizes with from 2 to 21 zones. Young CS units can be selected and assembled in any combination from simple ventilating to complete air conditioning.

"TAILOR-MADE INSTALLATIONS"

It is easy to choose a "tailor-made" unit to meet the most exacting air conditioning requirements. Selection of Coils, Humidifiers, Dampers, Mixing Boxes, and Filters is simply made . . . principal sections are interchangeable, making them easy to install. Ample access panels and doors are installed to permit ready inspection and servicing in the field.

Write to Dept. 570-C for Catalog No. 7558 for complete details

Young

YOUNG RADIATOR COMPANY

GENERAL OFFICES: RACINE, WISCONSIN

Plants at: Racine, Wisconsin and Mattoon, Illinois

Hand Torches. Newly revised, 36-page Catalog 818 covers this manufacturer's complete line of gas welding and cutting hand torches, outfits, tips and accessories. Included are general descriptions, features, specifications and product illustrations, with charts on welding and cutting tips listing pertinent information for making proper selection. Information on many new products and improvements is contained, including a general purpose welding torch with stainless steel head and fixed flow valves, two series of hand cutting torches, four cutting attachments, Bernz-O-Matic kits for utility flame heating applications, natural gas heating and brazing tips and a wide variety of cutting and washing tips.
Air Reduction Sales Company Div, Air Reduction Company, Inc., 150 E. 42nd St., New York 17, N. Y.

Control Apparatus. Provided in 54-page Bulletin ED-93 is a descriptive interpretation of basic controller selection considerations, the available types of reduced voltage and high voltage controllers, their individual operational and performance characteristics and their construction and design features. Also included for this line of control apparatus for hermetic centrifugal compressor applications are sections on auxiliary starting equipment, individual controller ratings and the writing of engineering specifications.
Cutler-Hammer, Inc., 501 N. 12th St., Milwaukee 1, Wisc.

Diesel Electric Plants. Powered by 2000, 5000 and 7500-watt Diesel engines, the electric plants presented in this 12-page booklet were engineered for construction, marine, railroad and industrial markets. Fuel economy and fast cold weather starting are cited as being assured by the engine's direct injection combustion system. Model specifications, standard equipment and product illustrations are included.
Kohler Company, Kohler, Wisc.

Thermocouple Adapter. Descriptive of a spring-loaded bayonet-lock thermocouple adapter which converts ⅛ or 1/16-in. diam metal-sheathed thermocouples to the spring-loaded, bayonet-lock type with adjustable immersion lengths is Flyer 2A. Full specifications concerning all parts of the adapter, their applications and limitations at various temperatures, are given.
ThermoElectric Company, Inc., Saddle Brook, N. J.


TORRINGTON HAS ANALYZED THE INPUT TO OUTPUT EFFICIENCY CORRELATION IN THOUSANDS OF DIVERSIFIED APPLICATIONS OF AIR MOVING COMPONENTS
FOR COOL HORSEPOWER IN ALL KINDS OF AIR MOVING REQUIREMENTS:
FROM THE HEAVY-TONNAGE SPECIFICATIONS FOR HEATING, VENTILATING AND AIR CONDITIONING PRODUCTS TO THE ULTRA-PRECISE COOLING REQUIREMENTS OF SPACE-AGE ELECTRONICS EQUIPMENT.
THAT'S WHY ENGINEER TOSS THEIR AIR MOVING PROBLEM TO TORRINGTON!
THE TORRINGTON MANUFACTURING COMPANY
TORRINGTON, CONNECTICUT • VAN NUYS, CALIFORNIA • OAKVILLE, ONTARIO

Curtis COOLS

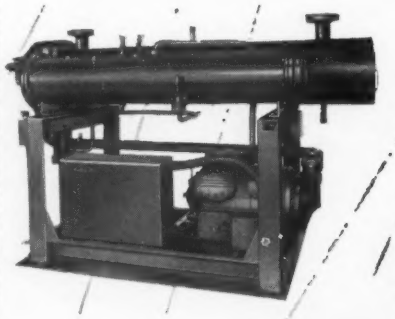
the world's "HOTTEST" towboat...



Huge 180 foot Federal Barge Lines towboat, the United States, has 50% greater horsepower than the largest towboat on the rivers. It can push 40 barges, totaling 1/3 mile, or 300 ft. longer than the "Queen Elizabeth".

C-100

Space saving design versatility? Easy installation? Operating dependability? Comparative cost? All these factors were considered by St. Louis Shipbuilding and Steel Company in the selection of air conditioning equipment for the world's most powerful towboat. The shipbuilders' and their design engineers' careful choice? A Curtis 20-ton packaged liquid chiller system. This equipment will cool the crew's quarters, galley, mess room, officers' and guest quarters—all with individual room or area temperature control.



The Curtis complete line, and reputation for dependability in installations of all types, work to the benefit of engineers and mechanical contractors. Factory run-in of all units cuts call backs far below average. You can safely promise dependable performance always up to, and frequently surpassing, rated capacity. You eliminate your problems when you specify Curtis, because you're working with an outstanding manufacturer of air conditioning equipment.

THE COMPLETE LINE OF LIQUID CHILLERS • PACKAGED AIR CONDITIONERS • CONDENSING UNITS

Curtis

ESTABLISHED IN 1854

MANUFACTURING COMPANY • REFRIGERATION DIVISION • *St. Louis 33, Missouri*

Tecumseh

engineering VISION

offers 23 BASIC COMPRESSORS for room cooler applications

1959 MODELS/HORSEPOWER ½ to 2 HP/BTU RATING FROM 5000 to 24,000



MODEL AU14
7 Pancake Models
½ — 1 HP

MODEL S1T16
2 Single cylinder
1 HP Models

MODEL B1616
4 1 HP Twin
Cylinder Models

MODEL B21U18
10 1½ to 2 HP Twin
Cylinder Models

Unquestionably the most complete line of air conditioning compressors in the industry. Tecumseh product development offers new pancakes with major price savings, compactness, top capacity and greater flexibility in the design of machine compartments. Your choice from among these 23 basic compressors should pinpoint your specific job requirements.

The Model AR26 Pancake is the answer for a low cost, small size, lightweight compressor for Portable air conditioners.

The new AU Pancake Series expands this popular shell design to a line of 1 HP compressors including 7½ and 12 amp models. Two 1 HP single cylinder compressors are offered which can also be used for heat pump applications.

A complete line of twin cylinder models starting at 1 HP includes a 7½ and a 12 amp model, and the biggest capacity Twin on the market.

Within these models, variations in mounting parts, tubes, electrical characteristics, etc. are available. Whatever your requirements may be, the Tecumseh line of Air Conditioning Compressors will meet them and serve you better in every application. Investigate today.

TECUMSEH

The Leader Serving Leaders in the Air Conditioning and Refrigeration Industries

TECUMSEH PRODUCTS COMPANY

MARION, OHIO — **TECUMSEH, MICHIGAN**

EXPORT DEPT: P. O. Box 2280, 24530 Michigan Ave., W. Dearborn, Michigan
CANADA: Tecumseh Products of Canada Limited, 1667 Dundas St., London, Ontario.

Wayne County General Hospital and Health Center

Michigan's Newest, Most Modern Hospital and Health Center

ELOISE, MICHIGAN

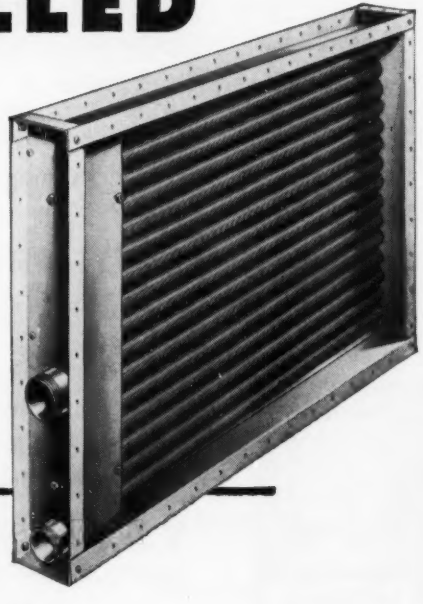


Smith, Hinchman & Grylls Associates, Inc.
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General Contractors

Lorne Plumbing & Heating Company
Plumbing-Heating-Air Conditioning

AEROFIN INSTALLED



Modern smooth-fin design of Aerofin coils permits ample heat-exchange capacity in limited space — permits the use of high air velocities without turbulence or excessive resistance.

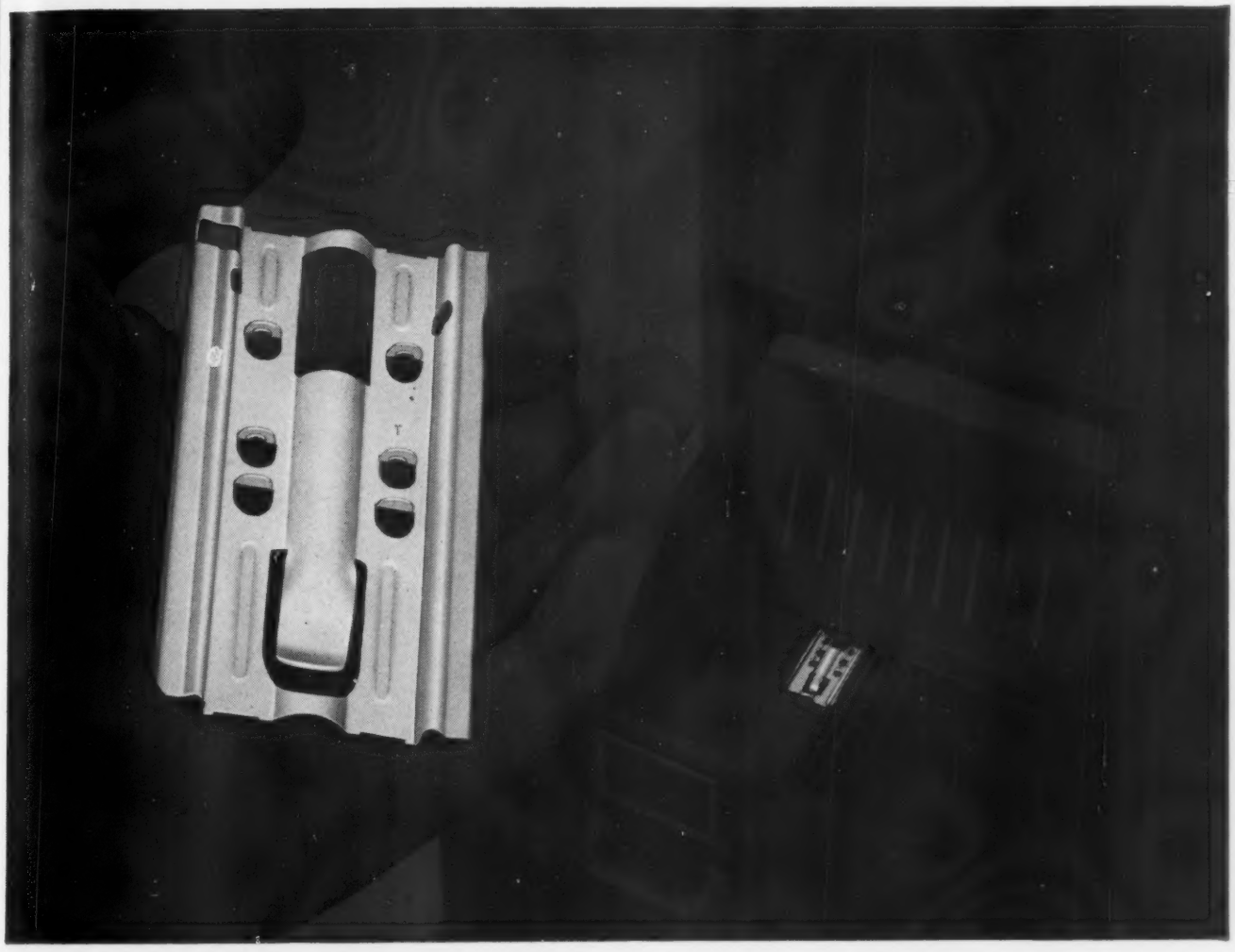
Aerofin performance data are laboratory and field proved. You can safely specify Aerofin coils at full published ratings.

AEROFIN CORPORATION

101 Greenway Ave., Syracuse 3, N. Y.

Aerofin is sold only by manufacturers of fan system apparatus. List on request.

ENGINEERING OFFICES IN PRINCIPAL CITIES



Engineered by Tinnerman...

Easier to assemble...easier to operate... **SPEED CLIP®** costs 50% less, too!

Assembly of the SUPER-FILER® *Divide-a-File* mechanism was considerably simplified when the General Fireproofing Company switched to a special SPEED CLIP design. Sightless people do the assembling without former difficulties of fitting spring wires into non-uniform stampings.

With this SPEED CLIP, the "self-adjusting" *Divide-a-File* slides more smoothly back and forth in the channel. Locking in the desired position is more positive, too.

This is another example of how Tinnerman Engineering goes far beyond the original fastening idea—how we work with customer engineering departments to produce better working units. And in the above case, a per-part cost reduction of 50% was achieved. In only 4 months, General Fireproofing had saved enough through lower assembly and parts costs to write-off new tooling needed to produce the SPEED CLIP.

You, too, can achieve savings and improvements like these on your assemblies. Invite your local Tinnerman sales representative in for a discussion of the SPEED NUT methods of better fastening at lower cost. He's listed in most Yellow Pages, under "Fasteners". Or write to:

TINNERMAN PRODUCTS, INC.
Dept. 12 • P. O. Box 6688 • Cleveland 1, Ohio

TINNERMAN
Speed Nuts®



FASTEST THING IN FASTENINGS®

CANADA: Dominion Fasteners Ltd., Hamilton, Ontario. GREAT BRITAIN: Simmonds Aerocessories Ltd., Treforest, Wales. FRANCE: Simmonds S.A., 3 rue Salomon de Rothschild, Suresnes (Seine). GERMANY: Mecano-Bundy GmbH, Heidelberg.



Now we're cooling with **GAS** *. . . and saving too!*

Arkla-Servel Gas Air Conditioning keeps work efficiency high and operating costs down at First Federal Savings in Alhambra, California.

"When planning our new main office in Alhambra, we made a complete survey of all types of air conditioning equipment," states First Federal. "Our answer was Arkla-Servel gas-operated water chilling units, and we're completely satisfied with the results.

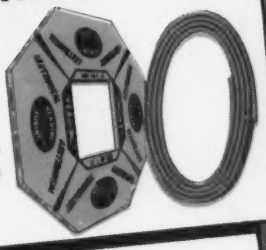
"With our Arkla-Servel units, we keep our staff cool in summer with the same compact system that keeps them warm in winter," adds Mr. D. A. Thompson, Sr., V.P. "We get top working efficiency at the lowest possible operating costs. And we get further savings because our Arkla-Servel unit is installed on the roof – utilizing otherwise useless space – and requires practically no maintenance."

Check the facts and you too will see that modern Gas air conditioning outperforms all others. For specific details call your local Gas Company's air conditioning specialist, or write to the Arkla Air Conditioning Corporation, General Sales Office, 812 Main Street, Little Rock, Ark.
American Gas Association.

IN TUBING, Nothing Beats Copper! IN COPPER TUBING, Nothing Beats READING!

For COPPER WATER TUBE

Specify READING "LEKTRONEAL"®



For COPPER REFRIGERATION TUBE

Specify READING "LEKTROSEAL"®



Also Specify READING

for
- COMMERCIAL COPPER TUBE
- RED BRASS & COPPER PIPE
- THREADLESS COPPER PIPE

For FINNED COPPER TUBE

Specify READI-FIN®

A line of heat transfer tubing made by Readi-Fin Mfg. Co., Inc. (a subsidiary of Reading Tube Corp., at Reading, Pa.). The extended surface is extruded from the tube wall, thus eliminating the possibility of fin failures resulting from thermal shock, corrosion and erosion. This "one-piece" (integral) construction provides maximum heat transfer efficiency, ruggedness, easy fabrication and freedom from fouling. It's available in Water Tube types with finned or plain ends and in Condenser Tube types with finned, plain or stripped ends.



For PRECISION COPPER TUBE Specify MACKENZIE WALTON

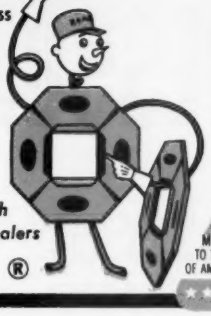
(A Subsidiary of READING TUBE CORP.)
PAWTUCKET, R. I.





- Famous for Accurate and Fine Finish Tubing
- Quality Controlled from Start to Finish

READING COPPER BRASS TUBE And RED BRASS PIPE



Sold Through Wholesalers Only ®

MADE IN U.S.A. TO THE STANDARDS OF AMERICAN INDUSTRY

READING TUBE CORPORATION

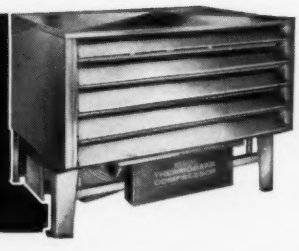
Empire State Building, New York 1, N. Y., Plant: Reading, Pa.

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ATLANTA, GA. 690 Murphy Ave. S.W., Unit 5, Bldg. B	**OAKLAND, CALIF.** 410 Hegenberger Rd.	**LOS ANGELES, CALIF.** 120 No. Santa Fe Ave.	**DENVER, COLO.** 2635 Walnut St.	**HOUSTON, TEXAS** 1121 Rothwell St.

DALLAS, TEXAS—9000 Sovereign Row, Brook Hollow Industrial District

THROW YOUR COMPRESSOR *OUT!



*OUTSIDE, THAT IS!

KRAMER'S outdoor compressor is the *only* compressor designed to operate *outdoors* for *any* application under *all* temperatures and weather conditions.

Completely assembled, wired, tested and factory run-in, it arrives on the job ready to operate. Simple hookup eliminates costly installation and control adjustment time. Kramer's outdoor compressor ends waste of valuable indoor space.

WRITE FOR BULLETIN

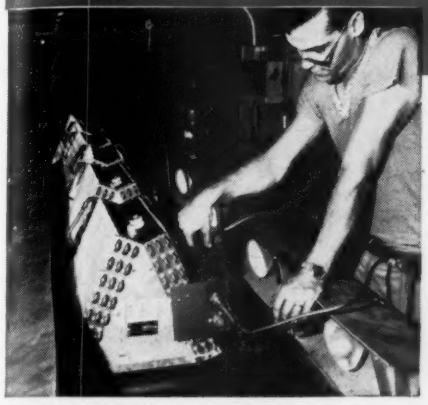
KRAMER

OUTDOOR COMPRESSOR

KRAMER TRENTON CO. • Trenton 5, N. J.

46 YEARS OF CONTINUOUS ACHIEVEMENT IN HEAT TRANSFER

Aeroquip 5500 Self-Sealing Refrigerant Couplings Simplify Charging and Installation of Package Units



The 5500 Self-Sealing Coupling is used for quick, easy pre-charging at the factory. This is the only charging operation necessary for components.





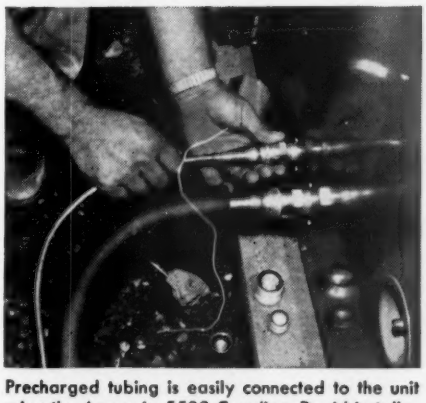
Condenser, evaporator, tubing . . . the complete package is pre-charged and stored indefinitely without leakage. Protective caps are slipped over coupling halves.

Installation of package refrigeration and air conditioning units can be done quickly, without evacuating and charging in the field. Using the Aeroquip 5500 Self-Sealing Coupling to join the components, all units and tubing of the system are precharged at the factory.

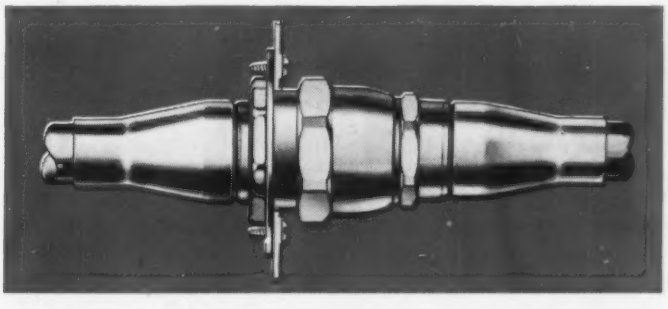
The coupling halves seal tightly when connected or disconnected, preventing the loss of refrigerant or entry of air into the system. Each half is brazed directly to the tubing, eliminating screwed joints and adaptors where leakage could occur. This permits the component sections to be charged with Refrigerant 12 and 22 and stored indefinitely without leakage.

Aeroquip 5500 Series Self-Sealing Couplings are available in sizes for ¼" to 1⅛" tubing.

For full details write for Engineering Bulletin IEB-32A.



Precharged tubing is easily connected to the unit using the Aeroquip 5500 Coupling. Rapid installation is possible because this leakproof coupling eliminates the need for bleeding and charging in the field.



Listed by Underwriters' Laboratories, Inc.

Aeroquip

REG. TRADEMARK



AEROQUIP CORPORATION, JACKSON, MICHIGAN

INDUSTRIAL DIVISION, VAN WERT, OHIO • WESTERN DIVISION, BURBANK, CALIFORNIA

AEROQUIP (CANADA) LTD., TORONTO 19, ONTARIO

LOCAL REPRESENTATIVES IN PRINCIPAL CITIES IN U.S.A. AND ABROAD • AEROQUIP PRODUCTS ARE FULLY PROTECTED BY PATENTS IN U.S.A. AND ABROAD



Consulting Engineers: Lockwood, Andrews and Newnam, Houston
Thermal Agent: McMillan Equipment Co., Houston

Thermal Vertical Central Plant

20 THERMAL Central Plant Units Air-Condition Houston Library

The Julia Ideson Building of the Houston Public Library was recently remodeled to include air conditioning. Here, again, Thermal equipment is providing the big difference in comfort for citizens reading for work or recreation.

The rapidly increasing number of buildings throughout the country using Thermal Engineering's air conditioning and ventilating equipment is recognition by architects, engineers and owners of its quality and service.

The Thermal line of finer equipment includes central and multizone conditioners, sprayed coil units, heating and ventilating units, heating and cooling coils, and air-cooled condensers. Types and sizes of all units are available to meet the architectural requirements of all kinds of buildings and weather conditions.

FOR YOUR LIBRARY—if you use information and specifications on air conditioning equipment, write for our complete catalog and a list of nationally known firms using Thermal Engineering's products.

Quality Products Since 1945

THERMAL ENGINEERING CORPORATION

2605 W. DALLAS • P. O. BOX 13254
HOUSTON 19, TEXAS

AGENTS IN PRINCIPAL CITIES

HENRY VALVE CO.

CONTROLLING FLOW SINCE 1914

DEMAND IS GREAT... EVERYONE IS BUYING THESE EXTRA VALUE PRODUCTS



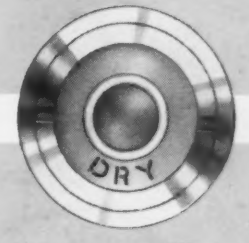
"DRI-VUE" Moisture-Liquid Indicators

"DRI-COR" Filter-Driers Molded Core

"GOLDEN BANTAM" Diaphragm Packless Valves

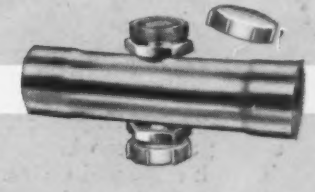
"DRI-VUE" INDICATOR PORT

Actually Spells "WET" or "DRY" with Color Variation.



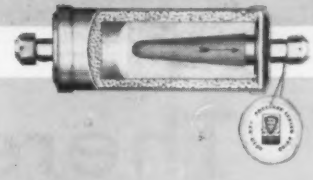
"DRI-VUE" INDICATORS

Double Port Moisture-Liquid Indicators, Large O.D.S. Sizes.



"DRI-COR" FILTER-DRIERS

Two Stage Drying; Molded Core and Granular Desiccant. Abso-dried.



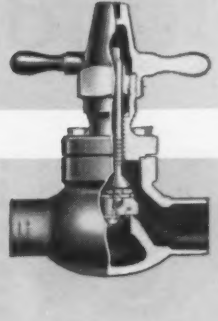
"DRI-COR" Cartridge DRIERS

Molded Filter Core and Granular Desiccant. Split Second Installation.



SHUT-OFF VALVES

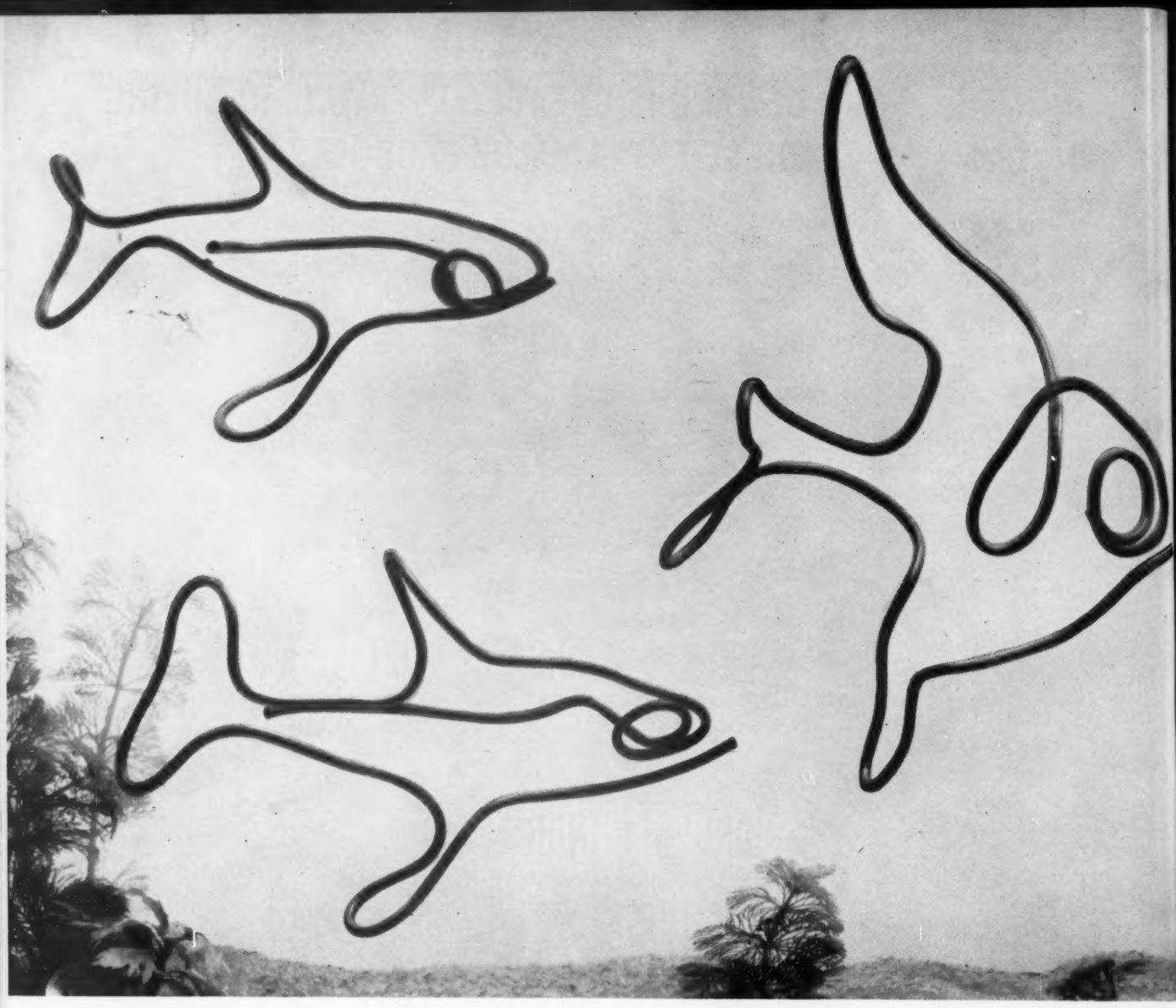
Packless and Packed with Flanged and Integral Connections. Wide Range of Sizes and Types.



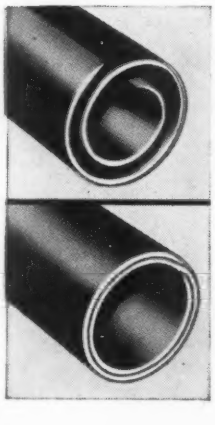
HENRY VALVE COMPANY

For Refrigeration, Air Conditioning and Industrial Applications

MELROSE PARK, ILLINOIS, U.S.A. CABLE: HEVALCO, MELROSE PARK, ILL.



There's almost no limit to the things Bundy can mass-fabricate



Bundyweld is the only tubing double-walled from a single copper-plated *steel* strip, metallurgically bonded through 360° of wall contact for amazing strength, versatility.

Bundyweld is lightweight, uniformly smooth, easily fabricated. It's remarkably resistant to vibration fatigue; has unusually high burstingstrength. Sizes up to ⅝" O.D.

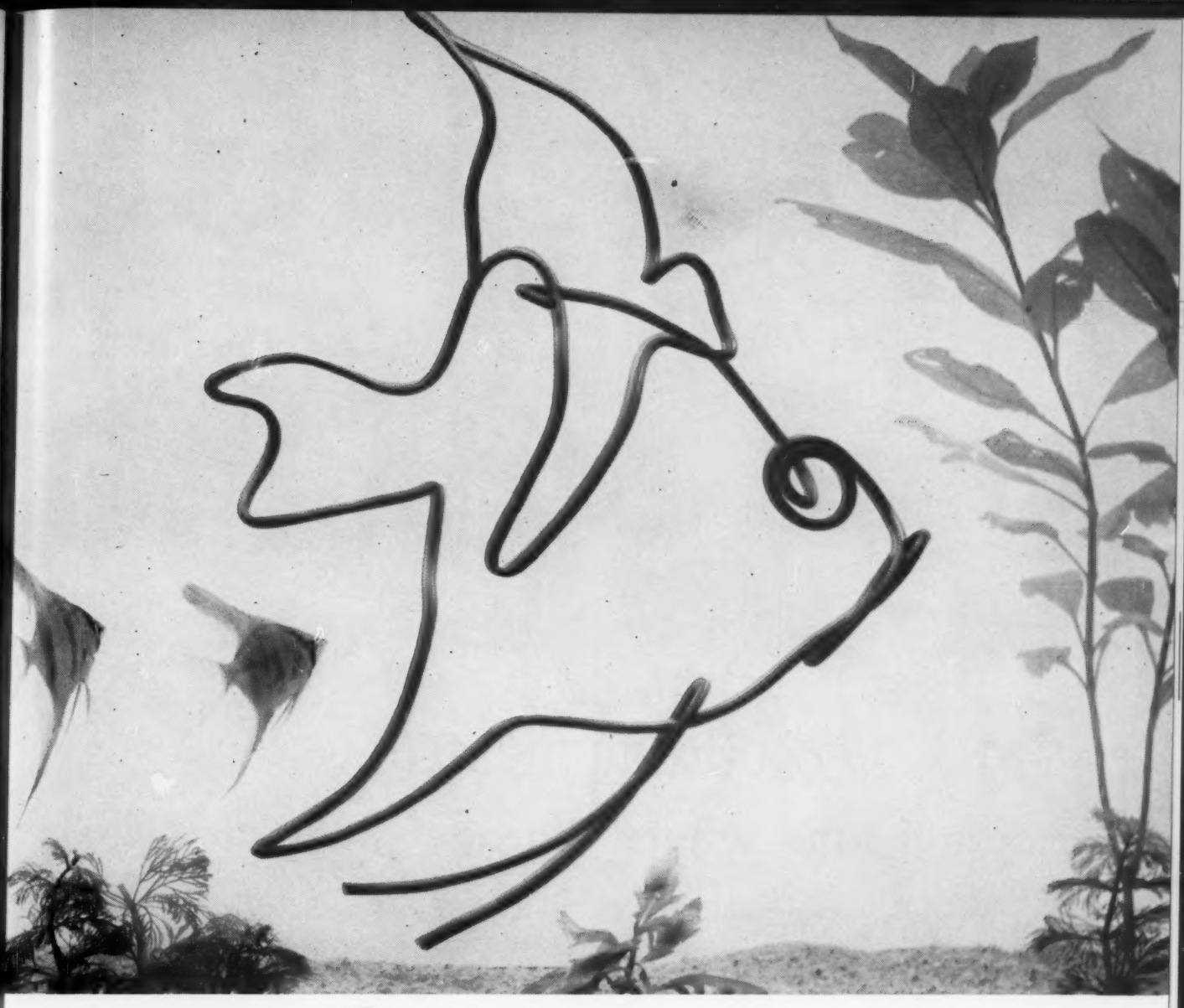
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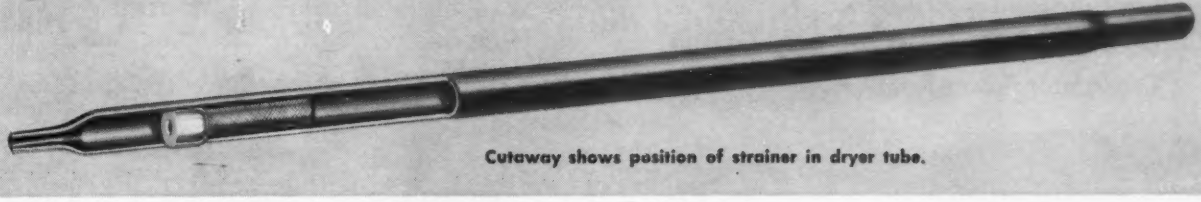
Bundyweld® Tubing is the safety standard of the refrigeration industry—double-walled from a ***single*** strip of steel, copper-brazed throughout, to make it leakproof by test. Covered by ASTM-254 and Govt. Spec. MIL-T-3520, Type III.

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Cutaway shows position of strainer in dryer tube.

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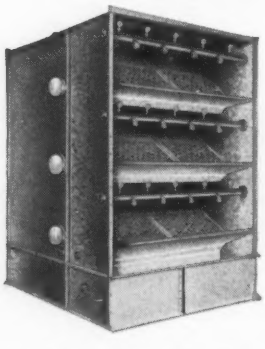
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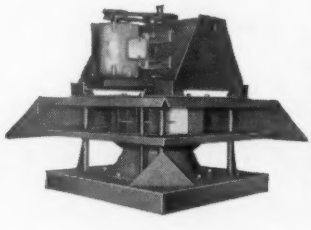
World-wide, Clarage quality is known and called upon. Down Mexico City way, for example, is the new Palacio de Hierro.

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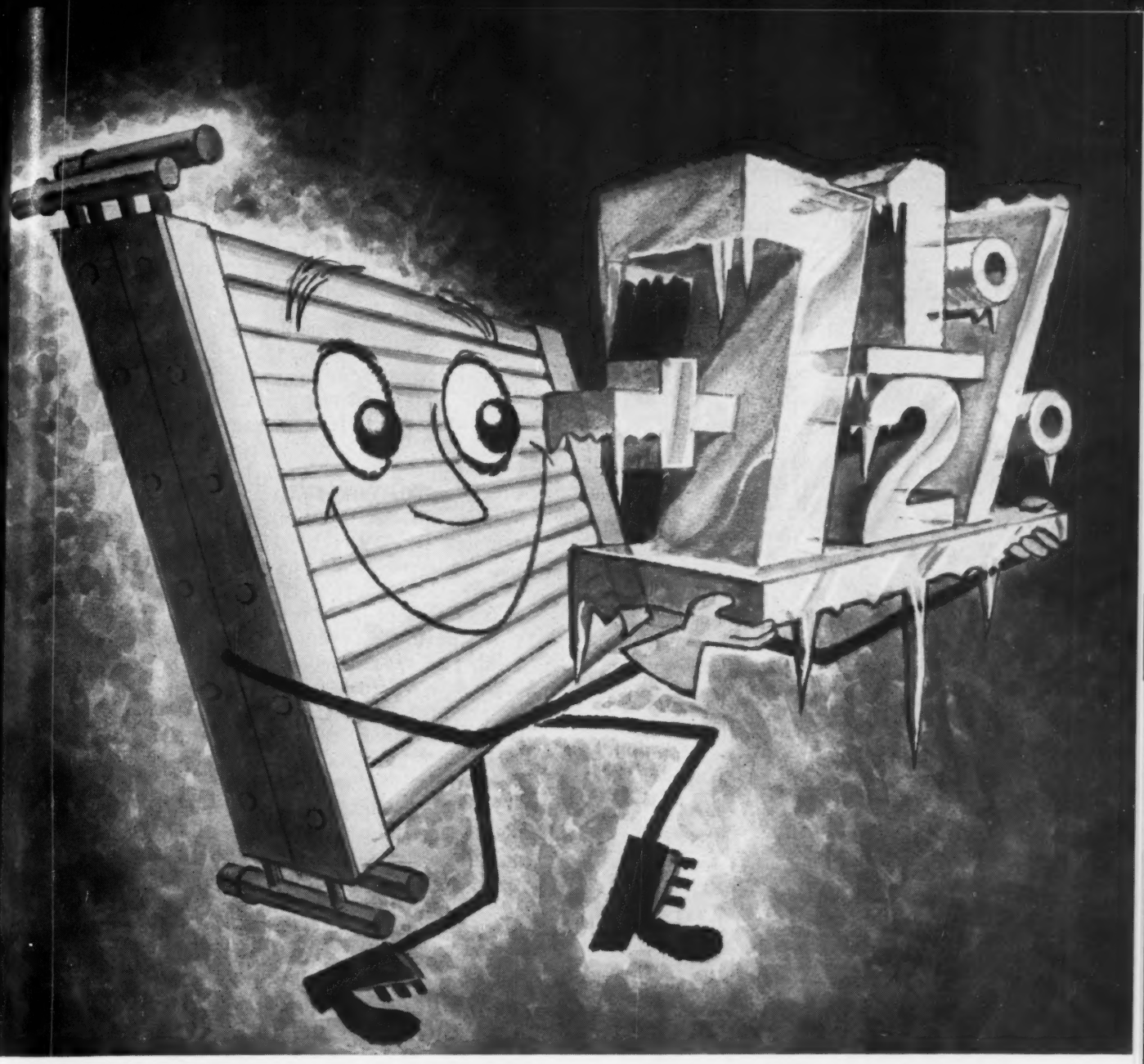
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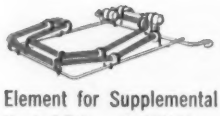
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Applications

ZONED COOLING FOR OUTDOOR RINKS

Incorporated in two outdoor ice rinks at Woodland Hills Park in Cleveland, Ohio, is a system that permits directing brine flow to compensate for spot melting. Hard skating surfaces can be maintained when atmospheric temperatures are above the freezing point.

Used in the two rinks, each having an area of 185 x 85 ft, is 100,000 ft of Jones & Laughlin one-in. pipe, installed in 180-ft lengths between headers and mounted on T-bars spaced approximately eight ft apart and having slots with four-in. centers. Pipe ends were welded onto 85-ft, three and one-half-in. headers at both ends of the rink area.

To provide an even ice temperature, the rink is divided into four zones of 64 pipes each in which the brine flows alternately in opposite directions. A special reversing valve permits directing more brine flow to any area that may be melting faster due to variation in the sun's rays.

Supply and return lines for the calcium chloride brine are six-in. seamless steel pipe through which pumps supply up to 1000 gpm of corrosion-inhibited brine to the piping in the skating area. Refrigeration equipment for each rink consists of one unit with two 75-ton Worthington compressors built on a special frame.

14-STORY HIGH BOILER

Designed for a pressure of 2700 psi, a power boiler, to be erected by Babcock & Wilcox Company at Consumers' Power Company's Essexville, Mich., plant, will have a rated continuous steam flow of 1,750,000 lb/hr at a pressure of 2450 psi and a temperature of 1050 F at the superheater outlet. When operating at rated capacity, the unit will burn more than 200,000 lb of coal per hr.

Steam generated by the boiler will be used to produce 265,000 kw of electrical power for the utility. Current total capacity of Consumers' system, which services most of Michigan's lower peninsula, is 2,270,000 kw.

SPECIAL UNITS AIR CONDITION NIKE TRAINING DEVICE TRAILERS

Equipment used in training Nike missile crews is contained in 20-ft air conditioned trailers, manned by five men. Maintaining comfortable conditions within these trailers are compact, five-ton systems utilizing electric resistance heaters developing 30,000 Btu/hr for winter heating. A centrifugal atomizer, supplied from a ten-gal water tank and controlled by a hu-

midistat, can add moisture to the air at the rate of five lb/hr.

On cooling cycle, the Carrier air conditioner will develop a full five-ton of capacity when outside air temperature reaches 120 F. Under these extreme conditions, it is capable of keeping the interior at 80 F dry bulb and 50% relative humidity. The refrigerating compressor runs continuously, but maintains temperature control by unloading first one, then both cylinders as interior thermostat settings are satisfied. 2500 cfm of filtered air, including 100 cfm of outside air, is distributed through a perforated ceiling, giving low velocity circulation without drafts. Power for the system comes from the same 30 kw, 400 cycle, dc generator which supplies the missile simulating equipment.

DOMED AUDITORIUM AIR CONDITIONED

With a dome roof 415 ft diam and 136 ft high, Pittsburgh's new Public Auditorium will be an open air stadium which can be converted quickly into a weatherproof, air conditioned auditorium.

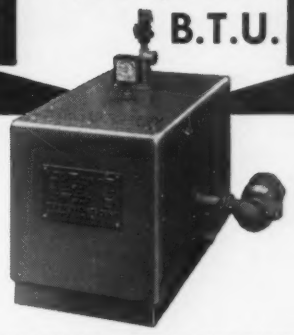
All public spaces in the structure will be air conditioned. These are on three levels, comprised of: on the lowest level, 50,000 sq ft of exhibition area, two meeting rooms and the main air conditioning mechanical equipment room; on the second level, main entrances and box offices, several private offices and three meeting rooms; and on the third level, seats and a control booth.

Designed so that only occupied portions of the building will be supplied with conditioned air, the system is to be a high pressure heating, ventilating and cooling system. Controls located in the equipment room on the first level will enable an engineer on watch to obtain temperature readings at six points in the auditorium, six points in the exhibit area and one in each of the meeting rooms.

Two main outdoor air intakes are located on the first level, with air being drawn through two main tunnels, 14 ft wide and 12 ft high, under the exhibit floor and then to four main risers where it will be drawn into the equipment rooms. Here it will be filtered, heated or chilled, mixed with recirculated air and distributed by ducts into the various parts of the system.

Servicing the main arena is a Trane "Open CenTraVac" centrifugal compressor driven by a 900-hp synchronous electric motor. Eight fan-coil equipment rooms will discharge 280,000 cfm of conditioned air through pylons around the periphery of the arena. A smaller Open CenTraVac driven by a 200-hp wound rotor induction motor supplies the main exhibition area with 66,200 cfm. Meeting rooms on the first and second levels have a 78-hp Cold Generator reciprocating water chiller, which supplies all five rooms. Each room on the first level will have air circulated at 4000 cfm, while the larger rooms on the second level will have a change of 12,800 cfm. Offices on the second level will have a 20-hp Cold Generator, with conditioned air circulated from two mechanical equipment rooms at 7200 cfm.

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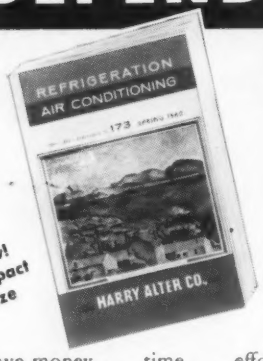
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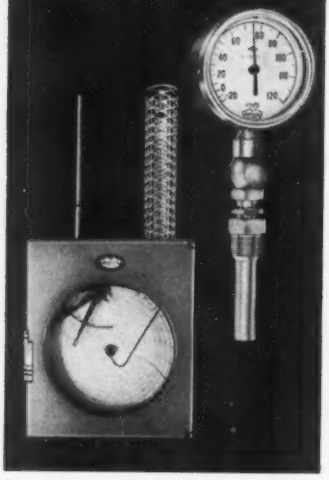
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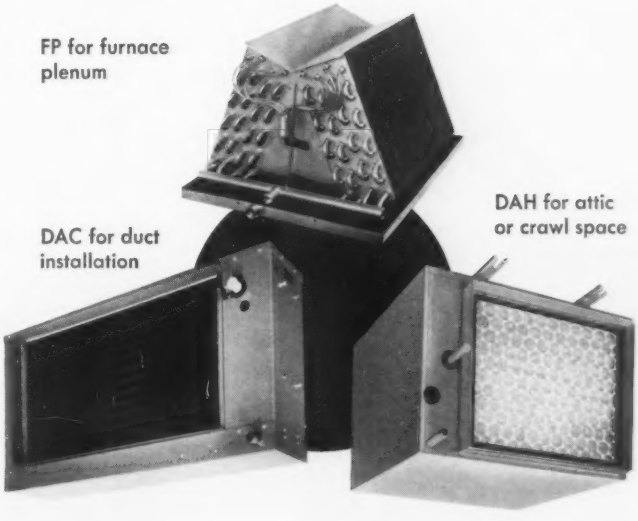
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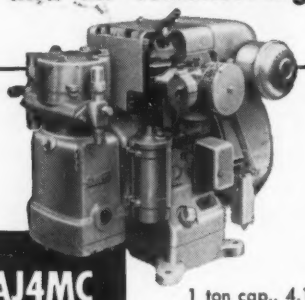
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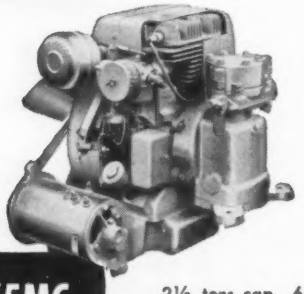
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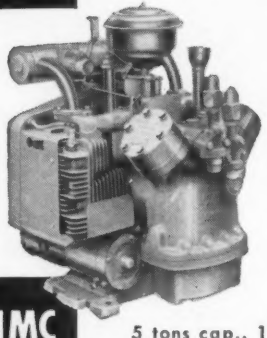
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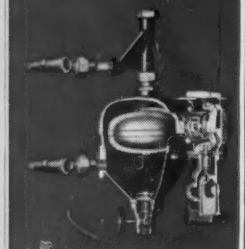
genetron 22 GREEN LABEL $CHClF_2$
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genetron 113 PURPLE LABEL $C_2Cl_3F_3$
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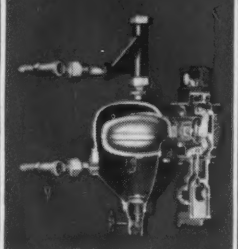
genetron 114a BLUE LABEL $C_2Cl_2F_4$
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GENERAL CHEMICAL DIVISION
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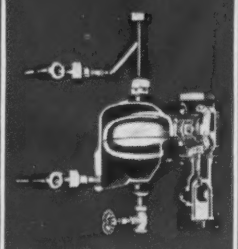
Allied Chemical



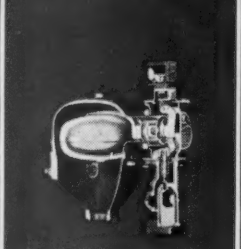
No. 47 Boiler Water Feeder for hand-fired steam boilers up to 5000 sq. ft.



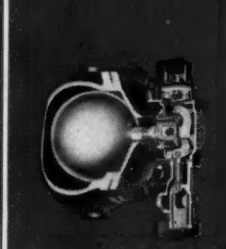
No. 47-2 Feeder Cut-off Combination for automatically-fired steam heating boilers up to 5000 sq. ft.



No. 147 Boiler Water Feeder — Like No. 47 but with higher feeding level for small process boilers.



No. 247-2—Feeder Cut-off Combination for small hot water space heating boilers.



No. 51-2 Feeder Cut-off Combination for automatically-fired heating boilers over 5000 sq. ft.



No. 53-2 Feeder Cut-off Combination — Like No. 51-2 but for higher pressures up to 75 lbs.



No. 67 Low Water Fuel Cut-off for low pressure automatically-fired steam boilers.



No. 63 Low Water Fuel Cut-off for hot water space heating boilers up to 50 lbs. pressure.



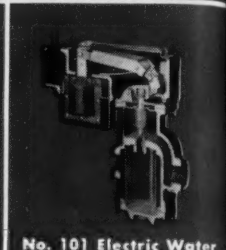
No. 69 "Built-in" Low Water Cut-off. One of many "built-ins" for installation in tapping provided in modern boilers.



No. 61 Low Water Fuel Cut-off for 1" equalizing pipe installation on low pressure steam boilers.



No. 767 Low Water Fuel Cut-off (with No. 14 blow-off) for installation in boiler opening.



No. 101 Electric Water Feeder — Operated by McDonnell two-switch cut-offs or liquid level switches.

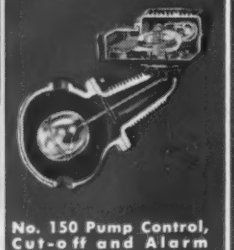
How many of these McDONNELL products do you know?

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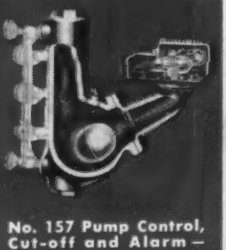
McDONNELL & MILLER, *Inc.* 3500 N. Spaulding Ave., Chicago 18, Illinois

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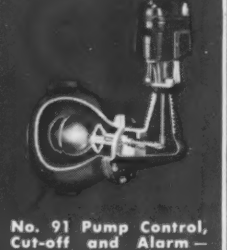
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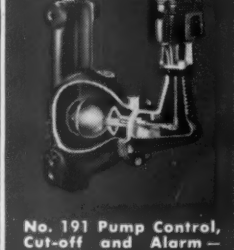
No. 150 Pump Control, Cut-off and Alarm Switch for boilers of any size up to 150 lbs. pressure.



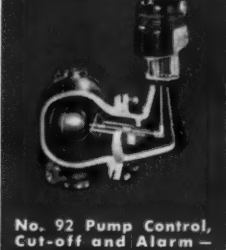
No. 157 Pump Control, Cut-off and Alarm — Like No. 150 but with integral water column.



No. 91 Pump Control, Cut-off and Alarm — New magnetic repulsion switching type for boilers of any size up to 150 lbs. pressure.



No. 191 Pump Control, Cut-off and Alarm — Like No. 91 but with integral water column.



No. 92 Pump Control, Cut-off and Alarm — new magnetic repulsion switching type for pressures up to 250 lbs.



No. 192 Pump Control, Cut-off and Alarm — Like No. 92 but with integral water column.



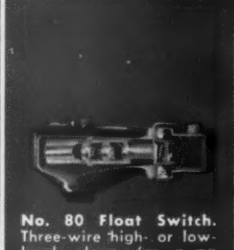
No. 355 Large Capacity Float Valve—many uses on tanks, stills, receivers, etc.



No. 4155 Feed Water Controller for multiple boiler jobs to divert pump discharge into proper boiler.



No. 65 Explosion-proof Electric Controller Underwriters' listed for hazardous locations.



No. 80 Float Switch. Three-wire high- or low-level alarm (or pump control) on oil storage tanks.



No. 21 Make-up Water Feeder for maintaining water level in receiving tanks — typical of series with flanges to fit existing tank openings.



No. 27T Make-up Water Feeder for external application on receiving tanks.



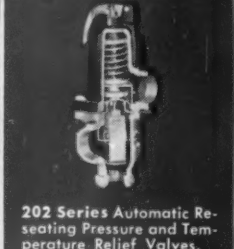
230 Series (ASME) Pressure Relief Valves for hot water boilers, tanks and heaters.



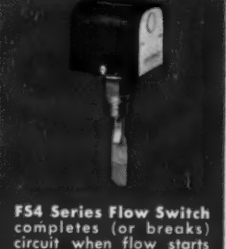
240 Series (ASME) Pressure Relief Valves for larger hot water boilers, tanks and heaters.



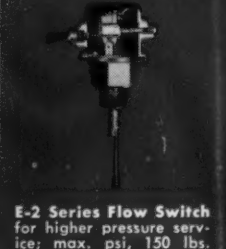
No. 201 Temperature Relief Valve for hot water tanks and heaters. A.G.A. tested, rated and listed.



202 Series Automatic Reseating Pressure and Temperature Relief Valves. ASME (NB) A.G.A.



FS4 Series Flow Switch completes (or breaks) circuit when flow starts or stops. Max. psi, 100 lbs. Underwriters' Listed.



E-2 Series Flow Switch for higher pressure service; max. psi, 150 lbs. Completely waterproof construction.